

Behavioral alterations and severity of pain in cats recovering at home following elective ovariohysterectomy or castration

Misse A-M. Väisänen, DVM, PhD; Suvi K. Tuomikoski, M Soc Sci; Outi M. Vainio, DVM, PhD

Objective—To identify behavioral alterations in client-owned cats recovering at home following elective ovariohysterectomy or castration and determine owner perceptions regarding severity of postoperative pain.

Design—Cohort study.

Animals—145 cats undergoing elective ovariohysterectomy (n = 80) or castration (65) at 4 veterinary clinics in Finland.

Procedures—Owners were asked to complete a questionnaire on their cats' behavior during the 3 days after surgery. Owners were also asked to indicate their perceptions of the severity of postoperative pain during these days by use of a 100-mm visual analog scale.

Results—Owners consistently indicated that there were changes in their cats' behavior, with the most commonly reported alterations being a decrease in overall activity level, an increase in the amount of time spent sleeping, a decrease in playfulness, and altered way of movement. Changes (ie, either an increase or decrease) in aggressive behavior were rare. Median pain score the day of surgery was 15.0 mm for male cats and 25.0 mm for female cats. Behavior score was significantly associated with day of observation, type of surgery (ovariohysterectomy vs castration), owner-assigned pain score, and veterinary clinic.

Conclusions and Clinical Relevance—Results suggested that behavioral alterations can be detected for several days after surgery in cats recovering at home following ovariohysterectomy or castration and emphasized owner concerns about the existence of postoperative pain. (*J Am Vet Med Assoc* 2007;231:236–242)

Behavioral symptoms are common in human patients recovering from anesthesia and surgery and are thought to reflect the effects of surgery-induced neuroendocrine and inflammatory responses,^{1,2} peri-anesthetic medications,³ and postoperative pain^{4,5} on mood, appetite, and demeanor. In adults and children, surgery and hospitalization have been found to affect several aspects of behavior, including sleep pattern,^{1,6,7} cognitive function,⁸ level of fatigue,⁹ and social interactions.^{3,5,10} A recent study¹¹ of client-owned dogs showed that postoperative behavioral alterations can also be identified in this species.

Knowledge of the characteristics of surgery-related behavioral changes in animals could aid in client communication and provide tools for future research into the perioperative management of veterinary patients. Despite the overall interest in improving veterinary care, little information is available on postoperative behavioral changes associated with common elective surgical procedures, especially among client-owned animals recovering at home.^{11,12} This is particularly true

for cats, compared with dogs, for which only limited information is available related to severity of postoperative pain, behavioral indicators of pain, and the overall effects of surgery on an animal's well-being.^{13,14}

The purpose of the study reported here, therefore, was to identify behavioral alterations in client-owned cats recovering at home following elective ovariohysterectomy or castration. Specifically, owners were asked to report on alterations in their cats' behavior and to rate the severity of postoperative pain each day for 3 days after surgery.

Materials and Methods

Study protocol—During a 10-week period in spring 2005, all owners who brought a cat to 1 of 4 veterinary clinics for elective ovariohysterectomy or castration were invited to participate in the study. Participating veterinary clinics consisted of the University of Helsinki Small Animal Hospital and 3 large to average-sized privately owned clinics in Finland. Participating clinics were selected by one of the authors (MV) and were located in the western, southern, and northern parts of the country; the selection process was not randomized.

Owners who agreed to participate were given an informational leaflet describing the study and asked to sign a statement of informed consent. Participating owners were asked to complete a questionnaire on their cats' behavior during the 3 days after surgery. The first

From the Department of Equine and Small Animal Medicine, Faculty of Veterinary Medicine, PO Box 57, 00014 University of Helsinki, Helsinki, Finland (Väisänen, Vainio); and Pohjola Non-Life Insurance Co Ltd, Lapinmäentie 1, FIN-00013 Pohjola, Finland (Tuomikoski). Dr. Väisänen's present address is Queen Mother Hospital for Animals, The Royal Veterinary College, Hawkshead Ln, North Mymms, Hertsfordshire AL97TA, London, England.

Supported by the Finnish Foundation of Veterinary Sciences. Address correspondence to Dr. Vainio.

observation day (day 1) started after the cat arrived home from the veterinary clinic, which most commonly occurred around noon or in the late afternoon on the day of surgery, and continued until the next morning. The following 2 days (days 2 and 3) each consisted of a 24-hour time period from one morning until the next morning. Owners were specifically asked to compare the cat's behavior on each day with its typical behavior before surgery and to return the questionnaire to the authors once observations for all 3 days had been completed. If the questionnaire was not received within 10 days after surgery, a single attempt was made by one of the authors (MV) to contact the owner by telephone and ask that the questionnaire be returned.

Participating veterinary clinics managed individual cats according to their own routine practices. Although anesthetic protocols varied, all clinics used a combination of an α_2 -adrenoceptor agonist and ketamine for anesthesia of cats. A record was kept of all medications administered while cats were hospitalized and of any adverse reactions, such as extreme excitement, that occurred.

Questionnaire—For the present study, a questionnaire regarding behavioral changes following surgery and severity of postoperative pain was created on the basis of behaviors reportedly used in published veterinary studies to estimate severity of postoperative pain and described in articles on pain management¹⁵⁻¹⁷ and on the basis of results of open-ended interviews with 7 owners of cats recovering at home following elective ovariohysterectomy or castration. Items included in the questionnaire were modified to resemble those used in a previous study¹¹ on postoperative behavior in client-owned dogs. The final questionnaire was tested with 5 additional cat owners for clarity and ease of use.

The questionnaire had 3 parts. The first part consisted of a list of 11 individual aspects of cat behavior for which owners were asked to indicate the extent and direction of change on each of the 3 days of observation. This included overall level of activity, time spent sleeping, playfulness, aggressive behavior, closeness (ie, the cat's desire to be in close proximity to a person), willingness to stay in the lap, attention seeking, withdrawal or hiding, vocalization (other than purring or hissing), purring, and appetite. Response options were clearly increased (+2), increased to some extent (+1), no change (0), decreased to some extent (-1), and clearly decreased (-2).

The second part of the questionnaire consisted of 9 statements about behavior for which owners were asked to indicate the degree of agreement on each of the 3 days of observation. Statements included the cat moves differently than normal, has a lower posture than normal, has a different demeanor than normal, sleeps in positions different than normal, sleeps in locations different than normal, is more restless than normal, is more fearful than normal, vocalizes differently than normal, and responds to touch differently than normal. Response options were yes clearly (+2), yes to some extent (+1), and no (0).

Finally, the third part of the questionnaire consisted of a visual analog scale by which owners were asked to indicate the intensity of pain they thought their cats had experienced on each of the 3 observations days.

The scale consisted of a 100-mm line labeled "no pain at all" at one end and "extreme pain" at the other end, and owners were asked to indicate perceived severity of pain by placing a mark on the line. Owners were also asked to describe the behavioral signs they used to evaluate the severity of pain in their cats.

Additional postoperative data—Participating owners were asked to provide information on any analgesics administered at home, the duration of time the cat wore an Elizabethan collar, the duration of time the cat was left alone at home, and whether the cat appeared to be interested in the wound (eg, not at all interested in the wound or shows almost constant interest towards the wound). Owners were also asked to report whether the cat had any episodes of diarrhea, vomiting, panting, shivering, drooling, or lip licking and whether the cat appeared to be drinking more water than usual.

Other information—Background information obtained for cats included in the study consisted of age, sex, breed, whether the cat or any of the owner's other cats had previously undergone surgery, whether the current cat was the first cat in the family, and the number of cats and persons in the family. In addition, owners were asked to use visual analog scales to indicate their cats' overall sensitivity to pain (0 = not at all sensitive; 100 = extremely sensitive), the position of the cat in the family (0 = just an animal; 100 = a full member of the family), and the extent of anxiety or distress the owners themselves now experienced (0 = not at all stressed; 100 = extremely stressed).

Statistical analysis—Absolute values for the responses given to each of the 20 items in the first 2 parts of the questionnaire were summed to obtain a behavior score for each day of observation; potential scores ranged from 0 to 40. A pain score was obtained for each day of observation by measuring, in millimeters, the distance from the left end of the visual analog pain scale to the owner-created mark.

General linear modeling procedures were used to determine whether various potential explanatory variables were significantly associated with behavior score or owner-assigned pain score. The Tukey-Kramer method was used to adjust for multiple comparisons. Potential explanatory variables that were examined included day of observation (day 1 vs day 2 vs day 3), type of surgery (ovariohysterectomy vs castration), veterinary clinic, background information variables, variables related to additional postoperative data that were collected (excluding duration of use of an Elizabethan collar and reports on vomiting and other physical signs), and the behavior score or owner-assigned pain score. Because Elizabethan collars were used almost exclusively on female cats, duration of use of an Elizabethan collar was examined, along with the other variables, in a separate analysis involving only the female cats. κ Coefficients were calculated for all pairwise comparisons of the individual aspects of behavior; values were interpreted as suggested by Woodward,¹⁸ with κ coefficients > 0.75 considered to indicate excellent agreement and values < 0.40 considered to indicate poor agreement. All analyses were performed with standard software^a; values of $P < 0.05$ were considered significant.

Results

Demographics—A total of 146 questionnaires were returned for analysis. However, 1 questionnaire was not properly completed and was not used. Mean response rate for the 4 participating veterinary clinics was 93% (range, 86% to 100%). Eighty of the 145 cats (55%) included in the study were female cats that underwent ovariohysterectomy; the remaining 65 (45%) were male cats that underwent castration. In all female cats, ovariohysterectomy was performed through a ventral midline approach. A total of 7 owners were contacted by telephone because the questionnaire had not been received within 10 days after surgery. Reportedly, fewer than 10 owners refused to participate in the study.

Median age of the female cats was 12 months (range, 6 to 96 months); median age of the male cats was 10 months (range, 5 to 60 months). Three female cats, but none of the male cats, had undergone surgery previously; however, owners of 46 female and 48 male cats indicated that they owned (or had owned) other cats that had undergone surgery. Median number of cats in the household was 2 (range, 1 to 6 for the female cats and 1 to 7 for the male cats). Median number of persons in the household

was also 2 (range, 1 to 6 for the female cats and 1 to 5 for the male cats). Owners of 26 female and 10 male cats indicated that this was the first cat in the family.

Mean owner-assigned visual analog score for the cats' overall sensitivity to pain was 39 (range, 0 to 89) for the female cats and 35 (range, 0 to 98) for the male cats. Mean owner-assigned visual analog score for the position of the cat in the family was 86 (range, 33 to 100) for female cats and 83 (range, 0 to 100) for male cats. Mean owner-assigned visual analog score for extent of anxiety or distress owners were currently experiencing was 47 (range, 0 to 100) for owners of female cats and 47 (range, 0 to 100) for owners of male cats.

Anesthetic and analgesic protocols—For 3 of the participating clinics, cats were routinely anesthetized with medetomidine (80 µg/kg [36 µg/lb], IM) or xylazine (1 mg/kg [0.45 mg/lb], IM) in conjunction with ketamine (5 to 8 mg/kg [2.3 to 3.6 mg/lb], IM). If needed, a single dose of propofol was given to effect. At the remaining clinic, cats were anesthetized with a combination of medetomidine (20 µg/kg [9.1 µg/lb], IM), ketamine (1 mg/kg, IM), and butorphanol (0.2 mg/kg [0.09 mg/lb], IM), and anesthesia was maintained with isoflurane in oxygen.

Table 1—Owner-assigned scores for the extent and direction of change in various behaviors for 145 cats recovering at home following elective ovariohysterectomy (n = 80) or castration (65).

Behavior	Owner-assigned response scores									
	Day 1					Day 3				
	-2	-1	0	1	2	-2	-1	0	1	2
Overall activity level	41	32	20	7	0	2	22	58	7	11
Time spent sleeping	2	4	20	42	32	0	9	62	6	23
Playfulness	52	24	21	3	0	7	22	55	5	11
Aggressive behavior	8	4	85	3	0	3	6	86	0	5
Time spent close to owner	4	12	27	37	20	0	6	56	11	27
Time spent in owner's lap	5	12	40	26	17	0	4	76	6	14
Attention seeking	13	14	36	26	11	2	9	52	11	26
Withdrawal	8	13	57	17	5	3	12	79	0	6
Vocalization	33	23	34	8	2	13	13	60	5	9
Purring	26	22	37	10	5	3	10	69	4	14
Appetite	21	24	32	17	6	1	13	59	8	19

Owners were asked to indicate the extent and direction of change for each of the 11 individual behaviors, compared with the typical behavior of their cats. Scores were defined as follows: -2 = clearly decreased; -1 = decreased to some extent; 0 = no change; 1 = increased to some extent; and 2 = clearly increased. Data are given as percentage of cats.

Table 2—Owner-assigned scores for the extent of change in various behaviors for 145 cats recovering at home following elective ovariohysterectomy or castration.

Behavior	Owner-assigned response scores					
	Day 1			Day 3		
	0	1	2	0	1	2
Way of movement	17	34	49	76	20	4
Posture (lowered)	42	29	29	82	15	3
Demeanor	30	31	39	81	17	2
Sleep (position)	43	36	21	81	14	5
Sleep (location)	49	35	16	82	15	3
Restlessness (increased)	63	26	11	85	14	1
Fearfulness (increased)	60	29	11	89	7	4
Vocalization	70	23	7	84	14	2
Response to touch	57	36	7	81	16	3

Owners were asked to indicate the extent of change for each of the 9 individual behaviors, compared with the typical behavior of their cats. Scores were defined as follows: 0 = no change; 1 = changed to some extent; and 2 = clearly changed. Data are given as percentage of cats.

For postoperative analgesia, all the cats received a single dose of carprofen (4 mg/kg [1.8 mg/lb], SC). At 2 of the clinics, female cats were also given a single dose of buprenorphine (0.01 mg/kg [0.0045 mg/lb], IM). At 1 clinic, cats were given atipamezole to reverse the effects of the α_2 -adrenoceptor agonist before discharge from the hospital. Analgesics were administered at home to only 4 of the 145 cats.

Changes in behavior—For all but 2 of the 20 individual behavior items on day 1 (aggressive behavior and attention seeking) and all but 1 of the items on day 2 (aggressive behavior), the percentage of female cats with a change in behavior was significantly higher than the percentage of male cats with a change in that behavior. For the 20 individual behavior items on day 1 (ie, the day of surgery), median percentage of female cats with a change in each behavior item was 68% (range, 15% to 91%), and median percentage of male cats was 54% (range, 16% to 79%). On day 3, median percentage of female cats with a change in each behavior item was 31% (range, 14% to 56%), and median percentage of male cats was 16% (range, 6% to 40%). The values for day 2 fell between those recorded for days 1 and 3. For both the female and male cats, the 4 behavior items for which a change was most commonly reported were overall activity level, time spent sleeping, playfulness, and way of movement (Tables 1 and 2). When κ coefficients were calculated for all pairwise comparisons of the 20 individual behavior items, none of the coefficients was > 0.75 , and 95% were < 0.40 .

Severity of postoperative pain—On day 1, owner-assigned pain score was < 30 mm for 51 of the 65 (79%) male cats but for only 34 of the 80 (43%) female cats (Figure 1). Median pain score on day 1 was 15.0 mm (range, 0 to 64 mm) for the male cats and 25.0 mm (range, 0 to 86 mm) for the female cats. Median pain score on day 2 was 8 mm for both the female and male cats (range, 0 to 65 for the female cats and 0 to 75 for the male cats). Median pain score on day 3 was 2.0 mm (range, 0 to 63 mm) for the male cats and 5.0 mm (range, 0 to 62 mm) for the female cats.

One hundred thirty owners provided information on the behavioral signs they used to determine whether pain was present or absent. Behaviors most commonly reported as indicative of the presence of pain included an altered way of movement or difficulties when jumping (20 owners [15%]), decreased level of activity (10 [8%]), withdrawal or hiding (10 [8%]), increased desire for human company (9 [7%]), altered response to touch or not wanting to be touched (9 [7%]), altered facial expression (8 [6%]), and altered posture (7 [5%]). Behaviors most commonly reported as indicative of the absence of pain included a normal way of movement or normal ability to jump (27 [21%]), a normal level of activity (18 [14%]), a normal level of playfulness (10 [8%]), a lack of vocal complaints (9 [7%]), a normal appetite (9 [7%]), normal responses to touch (8 [6%]), and a lack of interest in the wound (7 [5%]). Owners also mentioned aggressiveness towards other cats (mentioned 4 times), holding back the ears (2), low tail carriage (2), low posture (2), interrupted stretching (2), “self-focus” (1), and a “blind stare” (1) as signs indicative of an animal’s pain.

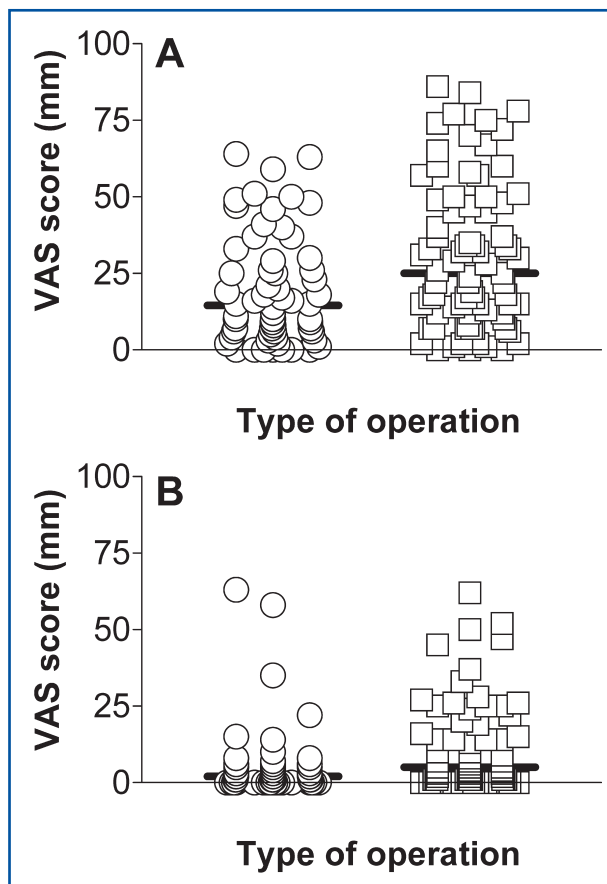


Figure 1—Owner-assigned visual analog scale (VAS) postoperative pain scores for cats recovering at home following elective castration (white circles; $n = 65$) or ovariectomy (white squares; $n = 80$). Black bar indicates median values. All cats received a single injection of carprofen for postoperative analgesia. Scores were assigned the day of surgery (day 1; A) and 2 days after surgery (day 3; B).

Additional postoperative data—Three cats reportedly had adverse events while hospitalized. In all 3, this consisted of muscle tremor thought to be related to ketamine administration. One cat received diazepam to relieve the tremors; all 3 cats recovered. In 1 cat, the sutures partly opened after surgery, and the cat was reexamined by a veterinarian. In another cat, the recovery process was slower than expected, and this cat was also reexamined by a veterinarian. Percentages of cats for which owners reported vomiting or diarrhea, panting or shivering, drooling or lip licking, and changes in drinking habits ranged from 25% to 78% for the 4 veterinary clinics. Vomiting and increased drinking were the most commonly reported signs. These signs were mostly described as single incidents and occurred on the day of surgery (day 1).

An Elizabethan collar or suit to cover the surgical wound was used in all but 14 of the female cats, but an Elizabethan collar was used on only 3 male cats. Eighty-four percent (range, 75% to 100%) of owners reported the cat as being “somewhat interested in the wound” during the 3-day period of observation. Owners reported that 77% (range, 75% to 87% for individual clinics) of cats were left alone at home for < 2 hours on day 1. On day 3, 72% (range, 70% to 84% for individual clinics) of cats were left alone at home for < 6 hours.

Table 3—Results of analysis of factors associated with owner-assigned behavior and pain scores for 145 cats recovering at home following elective ovariohysterectomy or castration.

Factor	Behavior score		Pain score	
	Absolute change	Percentage change	Absolute change	Percentage change
Behavior score*	NA	NA	9.3 (7.0–11.6)	NA
Pain score*	1.3 (1.0–1.7)	NA	NA	NA
Cat's sensitivity to pain*	NS	NS	1.2 (0.3–2.0)	NA
Age†	NS	NS	2.2 (0.4–4.1)	NA
Type of surgery‡	2.6 (1.0–4.3)	27	NS	NS
Day of observation‡	7.5 (6.1–8.8)	50	7.6 (3.1–12.1)	38
Veterinary clinic‡	3.9 (1.2–6.7)	42	7.1 (0.7–13.6)	56
Use of an Elizabethan collar§	4.7 (1.1–8.2)	48	NS	NS

*Increase in behavior or pain score associated with an increase in the factor's value of 10 units. †Increase in behavior or pain score associated with an increase in age of 12 months. ‡Increase in behavior or pain score associated with ovariohysterectomy, compared with castration; observation on day 1 (ie, the day of surgery), compared with day 3; and surgery performed at veterinary clinic 1, compared with the other clinics. §Increase in behavior or pain score associated with use of an Elizabethan collar after surgery (this factor was examined in a separate model that included only female cats).
NA = Not applicable. NS = Not significant.
Data are given as absolute change (ie, estimate of the mean difference; 95% confidence interval for the mean difference) or percentage change in score associated with a particular change in that factor. Behavior was scored on a scale from 0 to 40; postoperative pain was scored on a scale from 0 to 100.

Factors associated with behavior and pain scores—Behavior score (ie, the sum of the absolute values for the 20 individual behavior items) was significantly associated with day of observation, type of surgery (ovariohysterectomy vs castration), owner-assigned pain score, and veterinary clinic (Table 3). In the separate analysis involving only female cats, behavior score was significantly associated with use of an Elizabethan collar, day of observation, owner-assigned pain score, veterinary clinic, and owner-reported position of the cat in the family.

Factors found to be significantly associated with owner-assigned pain score were behavior score, age of the cat, day of observation, veterinary clinic, and cat's overall sensitivity to pain (Table 3).

Discussion

Results of the present study suggest that behavioral alterations can be detected in cats recovering at home following ovariohysterectomy or castration. The existence of behavioral alterations, particularly on the day of surgery (day 1), was not itself surprising, and some of these changes may merely have reflected recovery from anesthesia. Many of the behavioral alterations, however, seemed to be associated with changes in various aspects of animal behavior, as suggested by the owner, and were still evident in some cats 2 days after surgery, when they were unlikely to have been a result solely of perianesthetic medications. The low κ coefficients we obtained for pairwise comparisons of the individual behavior items suggested that individual items reflected separate behavioral alterations and emphasized the need for multiple observations to completely characterize surgery-related behavioral alterations in client-owned cats.

The most commonly reported behavioral alterations in the present study resembled those reported in an

earlier study¹¹ involving client-owned dogs recovering at home following soft tissue surgery. Increased fatigue and disturbances of sleep have been reported for up to 30% of adult human patients after major noncardiac surgery,^{1,7,9,19} whereas behavioral symptoms reported in children have included alterations in sleeping patterns, eating disturbances, and changes in social behaviors.^{3,5,6,10} Changes in behavior after surgical interventions are not unexpected and can be viewed to reflect the conscious and unconscious behaviors associated with avoidance of pain and the effects of the hormonal, metabolic, and inflammatory components of the perioperative stress response that modulates an individual's mood, appetite, and physical performance.^{1,2,9} With female cats in the present study, use of an Elizabethan collar significantly affected the overall extent of changes in behavior, but was not the only contributing factor. The postoperative use of an Elizabethan collar is often deemed necessary with veterinary patients, but its true effects on animal welfare have not yet been determined.

Among the interesting findings in the present study were the reported decreases in vocalization and changes in several aspects of social behavior. Although cats are not commonly thought to express pain through vocal complaint,^{16,20} our findings clearly demonstrate a change in this aspect of behavior, possibly reflecting the cat's altered mood or altered communication with the owner. Interestingly, cats were reported to increase their desire for human company after surgery, although both increases and decreases in withdrawal were also reported. Hiding and withdrawal have been regarded as indicators of pain in cats,^{14,15} although in the present study, owners cited both hiding and increased attention seeking as potential signs of pain. Notably, in many of the cats in the present study, changes in social behavior were still evident on day 3 following surgery, which contrasts with a recent suggestion that interactive behaviors in cats are normal 4 hours after surgery.²¹ The consistent reports on

lowered body posture, increased restlessness, altered responses to touch, and increased fearfulness seem further to emphasize that anesthesia and surgery do have a negative impact on well-being in cats.

Statistical methods were used to evaluate significant contributors to owner-assigned behavior scores in the present study. These analyses indicated that the type of surgery was significantly associated with behavior score, which is similar to conclusions of earlier studies involving human patients^{5,22} and dogs.¹¹ In the present study, the estimated difference was a 27% increase in behavior score for cats undergoing ovariohysterectomy, compared with cats undergoing castration. This difference may have implications for research as well as for clinical practice when the process of recovery needs to be monitored. Behavior score was also significantly associated with the owner-assigned pain score and vice versa, documenting a relationship between these 2 indices. However, the relationship was not especially strong, as an increase in behavior score of 10 units (on a 40-unit scale) was estimated to increase pain score by only 9 units (on a 100-unit scale). Such a result may reflect the uncontrolled nature of the circumstances of the present clinical study and the outcome variables used or the fact that not all surgery-related changes in animal behavior are attributable to postoperative pain.

Surprisingly, the type of surgery was not found to be significantly associated with owner-assigned pain scores in the present study. There was great variation in pain scores assigned by the owners, which possibly contributed to the finding, and the present study was not specifically designed to test this hypothesis. The lack of significance could also, to some extent, reflect the small difference in the degree of pain that cats experience after elective ovariohysterectomy versus castration when the operations are performed by veterinary professionals and analgesics are administered. In the present study, an increase in aggressive behavior was seldom reported, which could also implicate the presence of only mild or moderate degrees of pain. Both buprenorphine and carprofen have been documented to provide effective pain relief in cats after ovariohysterectomy or castration, with the effects of a single dose of carprofen lasting for most of the first postoperative day.²³⁻²⁵ However, wound tenderness is not prevented.²⁶ In the present study, the use of medetomidine and ketamine for anesthesia may have provided some benefit in the form of preemptive analgesia.²⁷

Importantly, owners of cats included in the present study were not specifically taught how to monitor their cats' pain, and our results must be viewed in this light. For example, a recent report²⁸ demonstrated the importance of including palpation in the assessment of pain in cats that have undergone ovariohysterectomy, and the assessment of pain in nonverbal patients is always met with challenges. No objective data currently exist on clinical signs indicative of postoperative pain in client-owned cats recovering at home, and this phenomenon should be examined further. The present study was not designed to determine the exact duration of postoperative pain in cats, and the appropriate duration of postoperative analgesic administration still needs to be determined.

Although the true extent of pain experienced by cats in the present study remains a matter of speculation, it is important to note that owners did report signs of pain, a finding that has direct implications for clinical practice. In humans, a visual analog scale pain score > 30 mm has been associated with at least a moderate degree of pain necessitating intervention.²⁹ The fact that owner-assigned pain scores were not significantly associated with the owner's own reported level of distress or with the use of an Elizabethan collar would further suggest that the assessments by the owners were genuine and reflected true perceptions of the presence of postoperative pain. Such concerns of owners should be addressed, and their clinical relevance should be examined.

Interestingly, a small but significant association between owner-assigned pain score and owner ratings of their cats' overall sensitivity to pain was also documented. This finding could reflect the scale used by owners when estimating the extent of pain or could indicate a true association between an animal's overall sensitivity to pain and the degree of pain experienced after surgery. The latter association has recently been demonstrated in human surgical patients,³⁰ and its existence warrants further attention among animal patients also.

There are several limitations of the present study that must be considered. First, participating veterinary clinics were not selected at random, and the clinics differed to some extent in the way they managed patients. In statistical analyses, clinic was significantly associated with both owner-assigned behavior scores and owner-assigned pain scores, but differences among clinics in regard to these outcomes were not consistent. Thus, the value of this finding is difficult to determine, as it may reflect the effects of the different perianesthetic medications, differences in surgeon skills, difference in owner characteristics, or overall differences in patient management. Secondly, it is not clear to what extent the present results are reflections of behavioral alterations that occur in cats recovering from different types of surgery with different types of anesthetic and analgesic protocols. The major factor in the present study was the use of a balanced anesthetic technique based on IM administration of an α_2 -adrenoceptor agonist and ketamine, which is a common technique used in cats in Europe and, to a certain extent, North America. Third, the study did not contain a control group to estimate the effects of hospitalization and anesthesia alone and was not able to cover all aspects of cat behavior. For instance, grooming and tail wagging were not included in the questionnaire. In addition, the behavior score used in statistical analyses provided only a crude estimate of the changes observed by owners, and an open-ended questionnaire would be needed to determine behavioral alterations the owners themselves would deem as the most important. Finally, several owner-related factors (eg, socioeconomic status) may have affected the present results in an undetermined manner.

In conclusion, results highlight the multifaceted nature of behavioral alterations in client-owned cats recovering at home following elective ovariohysterectomy or castration and emphasize owner concerns about the existence of postoperative pain. The data expand our understanding of cat well-being following surgery and can be used by practitioners when monitoring cats recovering at home.

a. SAS/STAT, version 9.1, SAS Institute Inc, Cary, NC.

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