

A preliminary study of behaviour-based indicators of pain in cats

N Waran*, L Best, V Williams, J Salinsky, A Dale and N Clarke

School of Natural Sciences, Unitec New Zealand, Carrington Road, Auckland, New Zealand

* Correspondence: nwaran@unitec.ac.nz

Abstract

The aim of this preliminary study was to identify key behavioural indicators of pain in cats. The behaviour of cats before and after ovariohysterectomy was analysed using a detailed behavioural ethogram. A comparison of behaviours between cats given pre-operative analgesia only and cats given both pre- and post-operative analgesia indicated that both groups demonstrated changed behaviour following surgery, compared to a control group of cats which underwent anaesthesia but not surgery. However, some specific postures, such as 'half-tucked-up' and 'crouching', were identified that occurred with greater frequency in the cats receiving pre-operative analgesia only, as compared to those receiving additional post-operative analgesia. This indicates that there are some key behaviours that may be useful in determining pain in cats. Routine administration of pre- but not post-operative analgesia may be ineffective for adequately alleviating pain in cats.

Keywords: analgesia, animal welfare, cat behaviour, ovariohysterectomy, pain

Introduction

The International Association for the Study of Pain (IASP) defines pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (IASP 1994). Pain, whether in humans or in animals, is a welfare issue and negatively affects quality of life. It provokes behavioural restriction, induces behavioural changes, and causes unnecessary fear, anxiety and stress. It complicates recovery from surgery by impairing normal biological and physiological functions.

Although there are limits to our knowledge of animal pain, including assessment of its degree and provision of appropriate analgesia, the majority of those working with animals do now accept that animals feel pain and would agree that "the inability to communicate verbally does not negate the possibility that an individual is experiencing pain and is in need of appropriate pain-relieving treatment" (IASP 1994). Veterinarians continue to debate the 'when', 'what' and 'how' of analgesia, but it certainly appears, from our comparison of surveys on the use of analgesia over a period of time, that the use of pain relief is increasing throughout the veterinary profession.

Although research has been carried out regarding potential behavioural indicators of pain in farm and laboratory animals (eg Molony *et al* 1995; Molony & Kent 1997; Molony *et al* 1997; Roughan & Flecknell 2000; Roughan & Flecknell 2001; Molony *et al* 2003) and in dogs (eg Conzemius *et al* 1997; Hansen *et al* 1997; Hardie *et al* 1997; Holton *et al* 1998; Firth & Haldane 1999; Holton *et al* 2001), there has been relatively little research concerning the identification of pain-related behaviours in companion

animal species such as cats (Cambridge *et al* 2000). Lack of knowledge of objective measures of pain means that some animals may experience sub-optimal pain management. In addition, there may be evidence for 'speciesism' (ie discrimination between species) with respect to pain relief for cats following surgery.

Recent work has shown that pre-operative analgesia is often considered more effective than post-operative analgesia, as a result of blocking or preventing the development of central sensitisation following surgical stimulation (Lascelles & Waterman 1997). In addition, it is clear that cats are generally given less pain relief than dogs. One survey (Capner *et al* 1999) revealed that 53% of cats undergoing ovariohysterectomy received routine pre- and post-operative analgesia, compared to 97% of dogs. In a more recent survey, the percentage of vets who provided pre- and post-operative analgesia for ovariohysterectomy in New Zealand was lower in cats (64%) than in dogs (76%) (Williams *et al* 2005). It is interesting to consider the possible reasons for this difference. Williams *et al* (2005) showed that although pain scores (from 1 to 10, where 1 was minimal and 10 was maximal pain) assigned by veterinarians to cats and dogs for ovariohysterectomy were not markedly different (1–3: dogs 5%, cats 12%; 4–7: dogs 73%, cats 74%; 8–10: dogs 22%, cats 15%), analgesia use did vary. 76% compared to 64% of veterinarians used routine pre- and post-operative analgesia for dogs and cats, respectively, while 39% compared to only 22% used more than one analgesic drug. One possible reason for the higher level of treatment for dogs is that their pain-related behaviour is more overt. But does this simply mean that we are failing to recognise behaviours in the cat that are

Table 1 Median frequency of observations of 'half-tucked-up' posture, pre- and post-surgery in adult cats.

Treatment/ time period	Pre- operative	1st hour post- operative	Post- operative (5 h)
Group 1 (pre-operative analgesia only)	1.7	6.7	29.2
Group 2 (pre- and post- operative analgesia)	3.5	9.5	12.5
Group 3 (control)	0	0	0.4

indicative of pain? The aim of this study was, therefore, to identify any specific behavioural responses (indicators) that occur in cats following ovariohysterectomy that may be indicative of pain.

Materials and methods

The study was undertaken at a Society for the Prevention of Cruelty to Animals (SPCA) shelter in Auckland, New Zealand, using cats and kittens that underwent routine ovariohysterectomy in 2005. All operations and procedures were carried out in a standardised manner by the same veterinary team, and all observations were carried out by the same observer. The treatments took advantage of standard practice within the SPCA veterinary clinic, which included ovariohysterectomy of stray cats and kittens using pre-operative analgesia but no additional post-operative analgesia.

Protocol

Four groups of healthy cats/kittens were randomly allocated to treatment groups as follows:

- Group 1: 10 healthy cats (mature canines present) undergoing routine ovariohysterectomy were given the usual pre-operative analgesic but no additional post-operative analgesic.
- Group 2: 12 healthy cats (mature canines present) undergoing routine ovariohysterectomy were given the usual pre-operative analgesic and a post-operative analgesic.
- Group 3: 8 healthy cats (mature canines present) undergoing anaesthesia (induction and intubation) for X-rays (where the X-ray was non-invasive and nothing was found to be wrong with the cat) were opportunistically used as a control group.
- Group 4: 8 healthy kittens (mature canines not erupted) undergoing routine ovariohysterectomy with pre-operative analgesic.

Drug treatments

The standard pre-medication for adult cats administered subcutaneously 1 h prior to surgery comprised:

- Acetylpromazine at 0.07 mg/kg
- Atropine at 0.02 mg/kg
- Buprenorphine at 32.4 µg/kg

Anaesthesia in adult cats was induced with propofol at 6 mg/kg, and cats were intubated and anaesthesia maintained using isoflurane. The additional post-operative analgesia for Group 2 cats was provided in the form of carprofen at 4 mg/kg, given subcutaneously as soon as the cat could raise its head after surgery.

The standard pre-medication for kittens administered subcutaneously 1 h prior to surgery was buprenorphine at 30 µg/kg. Anaesthesia was induced with ketamine at 25 mg/kg and valium at 0.6 mg/kg, and kittens were intubated and anaesthesia maintained using isoflurane.

Observations

All cats and kittens were placed in cages at least 15 h before pre-treatment observations started, in order to accustomise them to the new surroundings. The animals were observed in their cages for 2 h prior to pre-medication and for 5 h following surgery. Behaviour was recorded using a scan sampling technique. The number of occurrences of each behaviour was sampled every 5 min over the observation period of 2 h before surgery and 5 h following surgery. The original ethogram consisted of a range of behaviours including: grooming (licking an area of the body); sleeping together (kittens only, asleep together or in close proximity to each other); head up (head off the ground if in lying position or held up if in sitting or standing position); head down (head on floor if in lying position or hanging down if in sitting or standing position); crouching (sternal recumbency, weight bearing on forelimbs); tucked-up appearance (tensed abdomen in sternal recumbency); half-tucked-up appearance (partially tensed abdomen in sternal recumbency); curled up in a ball (natural sleeping position for many cats); looking around at surroundings (alert to movement in surroundings); vocalisation; position in the cage (front, middle or back); smooching (rubbing body against surrounding surfaces); swaying; trying to hide; turning head towards surgical site; physically attending to site.

Data analysis

All frequency data were recorded onto SPSS version 12.0.1 for Windows (SPSS Inc, Chicago, USA). Additional categories were created by collapsing some behaviours into groups, such as 'active' and 'inactive'. Friedman's ANOVA was used to determine whether there were any overall differences in post-operative behaviour between the treatment groups. If a group difference in the frequency of a specific behaviour was found to occur, *post hoc* Mann-Whitney *U* tests were used to determine between which groups the difference was most significant. The test is performed by ranking the combined data set, dividing the ranks into two sets according to the group membership of the original observations, and calculating a two-sample *Z* statistic, using the pooled variance estimate. In addition, Wilcoxon signed-rank tests (for related samples) were used to determine whether there were behaviour-frequency differences pre- versus post-operatively within each treatment group, with each animal being used as its own control. Results were considered significant if $P < 0.05$.

Results

The results from this preliminary study showed that, for adult cats, there was a group difference in some behaviours pre- and post-surgery. *Post hoc* Mann-Whitney *U* tests revealed significant differences in the frequency of scans post-operatively for the 'half-tucked-up' posture (see Table 1), with Group 2 adult cats performing less of this behaviour post-operatively than Group 1 cats ($Z = 5.376$, $P < 0.05$). In addition, Group 1 cats showed an increased frequency of crouching behaviour ($Z = 9.088$, $P > 0.05$) as well as greater attendance to the surgical site ($Z = 4.713$, $P < 0.05$), both through turning towards it and physically attending to it, compared with Group 2 cats.

A difference was also noted in the incidence of certain behaviours over time, with the highest frequency of abnormal postures being observed during the first hour following recovery from surgery, as illustrated for the 'half-tucked-up' posture (see Figure 1). The effect of the post-operative analgesic (given as soon as the animal lifted its head once in the recovery cage) is demonstrated by the reduction in the frequency of this posture seen after approximately 30 min of recovery time in Group 2 as compared with Group 1.

There were no significant differences between the pre- and post-operative behaviours in the kitten group, including the three behaviours, 'crouching', 'half-tucked-up' and 'attention to surgical site', in which differences were found in the adult group.

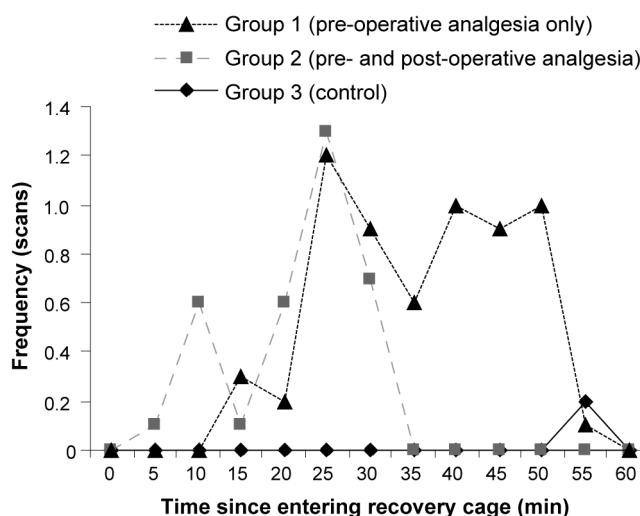
Discussion

It is clear that the recognition, evaluation and alleviation of animal pain associated with injury or disease is a fundamental objective for veterinary practitioners. Inadequate provision of analgesia may not only result in suffering but also prolong recovery. The results of this preliminary study demonstrate an objective approach that can be taken to identify and quantify behavioural changes associated with the use of analgesia. The results suggest that there are some key behaviours that may be used to identify pain; they also raise the question of whether current practice relating to pain management for cats undergoing ovariohysterectomy is sufficient for alleviating pain.

Can some behaviours be considered useful pain indicators?

Although preliminary analysis suggests that there was an overall difference in certain postures between the adult treatment groups pre- and post-surgery, with the post-surgical groups showing significant increases in the 'tucked-up' and 'curled up in a ball' postures and a significant decrease in activity, these differences occurred across treatment groups, and therefore did not relate to a specific treatment. They were, therefore, considered to be caused by the anaesthetic and/or effect of housing in the hospital and so are not likely to be useful as indicators of pain.

Figure 1



Changes in the median frequency of observations (scans) of 'half-tucked-up' posture over the first hour following recovery. Additional post-operative analgesia was given to Group 2 cats as soon as they had lifted their heads in the recovery cage. There is a reduction in the frequency of observations of the 'half-tucked-up' posture associated with additional post-operative analgesia during the first hour of recovery following ovariohysterectomy.

However, there were two postures, 'half-tucked-up' and 'crouching', that were considered to be useful indicators of pain because they were:

- Not seen prior to treatment
- Seen to occur at the highest frequency during the hour following surgery
- Observed to be highest overall in the group with no post-operative analgesia
- Seen to decline in frequency in the post-operative analgesia group over the first hour in the recovery cage following administration of the analgesic
- Easily recognisable

'Turning head towards surgical site' and 'time spent attending to site' also appeared to be greater in the group with no additional post-operative analgesia. However, although these can be considered to be recognisable behaviours, they may be more difficult to observe unless the animal performs them frequently or is under close observation so that changes in the frequency of these behaviours are monitored over time.

The effect of an additional (post-operative) analgesic

The results of this preliminary study suggest that the pre-operative pain relief provided for all cats undergoing ovariohysterectomy in line with standard procedure in many New Zealand practices (Williams *et al* 2005) may not be effective for managing pain. Robertson and Taylor (2004) state that feline pain has been under-treated

largely as a result of concerns regarding the side-effects of traditional analgesics and the limited number of pharmaceutical products with market authorisation for cats. It is also the case that drug-induced sedation during surgical procedures may mask the presence of pain by decreasing overt behavioural signs even though pain may not be attenuated (Lascelles *et al* 1995). We therefore consider it to be important to discriminate between sedation effects and analgesic effects on behaviour. Although pre-operative analgesia is thought to be more effective than post-operative analgesia, as it blocks the pain pathways before pain has occurred (Lascelles *et al* 1995), we also consider it to be important to continue providing analgesia post-operatively because of the continued pain input from the surgical site, which occurs as a result of post-operative inflammation (Robertson & Taylor 2004). It may be that the level of pre-operative analgesia provided for cats in this study was not sufficient to provide the full analgesic effect that was expected; however, a combination of both pre- and post-operative analgesia may reduce the likelihood that the animal's welfare will be compromised.

Is there an age effect in relation to pain?

There were no significant differences between the selected pre- and post-operative behaviours in the kitten group, including the three behaviours, 'crouching', 'half-tucked-up' and 'attention to surgical site', in which significance was found in the adult group. This may have been an age effect but may also be a result of the different drug protocols and thus merits further investigation.

Conclusion

These preliminary results suggest that pre-operative analgesia should be administered in conjunction with post-operative analgesia to achieve a complete analgesic effect for routine surgical procedures such as ovariohysterectomy in cats. The study has shown that behavioural indicators of pain in cats may include frequency of postures such as 'half-tucked-up' and 'crouching' as well as events such as 'turning head towards/paying attention to site'. These indicators may be useful for enabling practitioners and their staff to monitor the effectiveness of their pain management. Further studies are required regarding age effects in relation to pain indicators in cats, as well as more detailed analysis of behaviour following surgery.

Acknowledgements

We would like to thank Auckland Society for the Prevention of Cruelty to Animals for enabling this study to go ahead. We are grateful to the Companion Animal Society of New Zealand for funding.

References

- Cambridge AJ, Tobias KM, Newberry RC and Sarkar DK** 2000 Subjective and objective measurements of post-operative pain in cats. *Journal of the American Veterinary Medical Association* 217: 685-689
- Capner C, Lascelles B and Waterman-Pearson A** 1999 Current British veterinary attitudes to perioperative analgesia for dogs. *Veterinary Record* 145: 95-99
- Conzemius MG, Hill CM, Sammarco JL and Perkowski SZ** 1997 Correlation between subjective and objective measures used to determine severity of postoperative pain in dogs. *Journal of the American Veterinary Medical Association* 210: 1619-1622
- Firth AM and Haldane SL** 1999 Development of a scale to evaluate postoperative pain in dogs. *Journal of the American Veterinary Medical Association* 214: 651-659
- Hansen BD, Hardie EM and Carroll GS** 1997 Physiological measurements after ovariohysterectomy in dogs: what's normal? *Applied Animal Behaviour Science* 51: 101-109
- Hardie EM, Hansen BD and Carroll GS** 1997 Behaviour after ovariohysterectomy in the dog: what's normal? *Applied Animal Behaviour Science* 51: 111-128
- Holton L, Reid J, Scott EM, Pawson P and Nolan A** 2001 Development of a behaviour-based scale to measure acute pain in dogs. *The Veterinary Record* 148: 525-531
- Holton LL, Scott EM, Nolan AM, Reid J, Welsh E and Flaherty D** 1998 Comparison of three methods used for assessment of pain in dogs. *Journal of the American Veterinary Medical Association* 212: 61-66
- IASP** 1994 Task Force on Taxonomy. In: Merskey H and Bogduk N (eds) *Classification of Chronic Pain (2nd Edition)* pp 209-214. International Association for the Study of Pain: Seattle, USA
- Lascelles D and Waterman A** 1997 Analgesia in cats. *In Practice* 19: 203-213
- Lascelles B, Cripps P, Mirchandani S and Waterman A** 1995 Carprofen as an analgesic for postoperative pain in cats: dose titration and assessment of efficacy in comparison to pethidine hydrochloride. *Journal of Small Animal Practice* 36: 535-541
- Molony V and Kent JE** 1997 Assessment of acute pain in farm animals using behavioral and physiological measurements. *Journal of Animal Science* 75: 266-272
- Molony V, Kent JE and McKendrick IJ** 2003 Validation of a method for assessment of acute pain in lambs. *Applied Animal Behaviour Science* 76: 215-238
- Molony V, Kent JE and Robertson IS** 1995 Assessment of acute and chronic pain after different methods of castration of calves. *Applied Animal Behaviour Science* 46: 33-48
- Molony V, Kent JE, Hosie BD and Graham MJ** 1997 Reduction of pain suffered by lambs at castration. *The Veterinary Journal* 153: 205-213
- Robertson S and Taylor P** 2004 Pain management in cats — past, present and future. Part 2: Treatment of pain — clinical pharmacology. *Journal of Feline Medicine and Surgery* 6: 321-333
- Roughan JV and Flecknell PA** 2000 Effects of surgery and analgesic administration on spontaneous behaviour in singly housed rats. *Research in Veterinary Science* 69: 283-288
- Roughan JV and Flecknell PA** 2001 Behavioural effects of laparotomy and analgesic effects of ketoprofen and carprofen in rats. *Pain* 90: 65-74
- Williams VM, Lascelles BDX and Robson MC** 2005 Current attitudes to, and use of, peri-operative analgesia in dogs and cats by veterinarians in New Zealand. *New Zealand Veterinary Journal* 53: 193