HILLS: CAT FRIENDLY STREAM

Dr Andrew Sparkes,
BVetMed PhD DipECVIM
MANZCVS MRCVS

Veterinary Director
International Cat Care and
International Society of
Feline Medicine
Place Farm, Court Street,
Tisbury, Wilts, UK, SP3 6LW

andy.sparkes@icatcare.org

STRESS IN CATS – WHY IT OCCURS AND WHAT EFFECT IT HAS IN THE CLINIC

Stress is a very common phenomenon among feline patients although it is complex and can be difficult to define. Stress may be a combination of cognitive, emotional and somatic responses to various stimuli, some pleasant and some aversive. Short-term stress is a normal physiological response and in itself may be a healthy response. However, stress (short-term or long-term) may have deleterious effects on the welfare of the individual and as such may lead to distress (Levine 2008). It can complicate, confound or contribute to disease processes, and sometimes all three. Stress may occur for a number of different reasons, but often is a result of our lack of understanding of cats as a species, along with the lifestyle and environment we impose on them – whether in the clinic situation or at home.

The nature of the cat

Domestic cats are derived from the African wild cat, and remain extremely closely related to their wild ancestor. They have been tamed over a few thousand years of living in close proximity to humans, but with the exception of a few pedigree breeds, they cannot really be regarded as genuinely domesticated animals. Most are not dependent on humans and, in fact, are more than capable of living and thriving without any human intervention. However, cats are remarkably adaptable, and are able to co-exist with humans well for the most part.

Understanding what drives, motivates and shapes the behaviour of cats makes it easier to understand their unique needs, and why stress may affect them.

One of the classic examples of how humans have tried to manipulate cats is the move to keep them as predominantly or entirely indoor pets. As cats have assumed a greater role as a companion animal, they have become more valued as a 'member of the family'. In our desire to protect cats from various threats (motor vehicles, other cats, other animals, infectious diseases etc.), there has been a growing tendency to keep cats as indoor pets. This may appear logical, but such a lifestyle allows the cat relatively little opportunity to display its normal 'wild-type' behaviour. The cat becomes confined to a relatively small space, and an area that would certainly be much smaller than a territory it would choose for itself. This is taken to even further extremes when cats are confined to small apartments where space is very limited. This can be a significant cause of stress.

Cats are highly territorial animals - undesirable behavioural traits are undoubtedly much more common in cats that are kept confined indoors than those that are allowed outside where they can establish a more 'normal' territory. Cats become very strongly attached to their territory, often more so than to their owners - this can be a problem when the cat is taken out of its normal territory for whatever reason (eg, moving house, visit to the veterinary clinic etc.).

Many things can also threaten what the cat perceives as his or her territory. The cat may feel threatened by

- a neighbourhood cat encroaching in his/her territory
- another cat or dog that is introduced into the house
- structural changes in the environment
- a new person coming into their territory.

These and other perceived threats to their territory can be a cause of huge stress to cats. Cats generally will hide when threatened and it is important that they have spaces where they can hide away in their core territory.
Cats are also inquisitive explorers of their environment and they like to climb and perch on high objects where they can survey their environment. Cats need to be able to use all three dimensions of the space they are in and they need exercise and play.

Effect of stress in the clinic – physiological consequences:

One recent study (Quimby et al 2011) looked at the difference in measurement of a number of physiological parameters between measurement in the home environment (by a veterinary student) and measurement in a veterinary clinic (by the same student on the same day). This study was performed with 30 health cats owned by students and staff at the University of Colorado with parameters first being measured in the home environment and then in the clinic. A significantly different value was obtained

between the two measurements for blood pressure, heart rate and respiratory rate- all being lower in the home environment.

Parameter	Mean difference (Clinic – Home)	Range of differences
Blood pressure	6mm Hg	31mmHg to -26mmHg
Rectal temperature	0.3 F	2.1 F to -1.3 F
Heart rate	33 bpm	76 bpm to -26 bpm
Respiratory rate	12 bpm	108 bpm to -30 bpm

This study emphasises that clinically significant changes in these parameters can readily occur between measurements in the home and clinic environments, and also that the differences are highly variable between individual cats. However, the study also almost certainly underestimated the true differences in these parameters between cats in an un-aroused state at home and in an aroused state in the clinic, as a veterinary student entering the home who was unfamiliar to the cat performed the measurements. Interestingly, the study also assessed the attitude/temperament of the cats during the examination process. They were scored on a 3-point scale:

Feature (Score)
Calm (0) or Agitated (1)
Compliant (0) or Struggling (1)
Quiet (0) or Vocal/hissing (1)

They found that the attitude scores in the clinic environment were *lower* for 50% of the cats, the same for 30% and higher for just 20%. This at first sight appears counter-intuitive – the physiological parameters suggested that the cats were generally more stressed in the clinic environment but the attitude scores were lower. However, this again probably reflects that a student to whom the cat was unfamiliar performed the observations. Within the home environment, this student therefore represented a stranger entering their home territory and performing an examination. A cat is likely to often display different overt reactions in this situation compared with when it is in a clinic and away from its hoe territory.

This study therefore also highlighted the difficulty in correlating differences in attitude or behaviour with physiological stress, especially when comparing cats in different environments.

Other studies have also looked at the effect of stress on measurement of physiological parameters in cats. Belew et al (1999) used radiotelemetry to directly measure blood pressure and heart rate in a group of cats that underwent a simulated visit to a veterinary clinic and a clinical examination. They showed that compared with undisturbed 24-hour values, systolic blood pressure in healthy cats rose by an average of 17.4 mmHg during the clinical examination (from 126 mmHg to 143.4 mmHg) and heart rate rose from by 34 (from 181 bpm to 215 bpm). Similarly, in a study by Sparkes et al (1999) it was found that when measuring systolic blood pressure in cats by the Doppler methodology in a simulated clinical setting, there was a mean decrease in SBP of 19 mmHg when the cats were allowed 10 minutes to acclimatise to their room and the people performing the examination

Effect of stress in the clinic – laboratory consequences:
Stress can have quite profound effects on the haemogram in all species, and this is notably true in cats. In general, two types of changes to the haematology picture are seen which are often categorised as a *physiological leucogram* or a *stress leucogram*.

The 'physiological leucogram' is characteristic of an acute stress response medicated by catecholamine release. It is associated with a transient leucocytosis mediated in part through mobilisation of the marginating neutrophil pool. The resultant neutrophilia in cats may be marked because of their large marginating neutrophil pool. Lymphocytosis may also be seen with a physiological leucogram, and may be particularly marked in kittens and young cats. This is thought to arise from redistribution of lymphocytes from the lymphatics and lymphoid tissues to the blood.

The classic 'stress leucogram' is more associated with glucocorticoid release and is characterised largely by neutrophilia and lymphopenia. Monocytosis can be seen but is more a feature in dogs than in cats.

One of the best-recognised effects of stress in cats on laboratory parameters is their propensity to develop hyperglycaemia when stressed. This is a well-recognised phenomenon and has been shown to be associated with increased circulating concentrations of catecholamines, but again visible indicators of stress seem to have a poor ability to predict whether a cat is likely to have stress hyperglycaemia (Leidinger et al 1989). In one study, 12% of cats with stress hyperglycaemia exhibited blood glucose values above 16.7 mmol/l and they went as high as >34 mmol/l (Opitz 1990), thus stress can readily raise blood glucose levels above the renal threshold and cause glucosuria in a number of cats. In another study, stress hyperglycaemia (blood glucose >8 mmol/l) was present in more than 34% of over 2000 sick cats, with glucose concentrations varying between 8.1 and 60.4 mmol/l (Laluha et al 2004). The hyperglycaemia seen following an acute stressor appears to be mediated by increased hepatic gluconeogenesis (Feldhahn et al 1999), whereas other changes including cortisol-induced insulin resistance may contribute to the stress hyperglycaemia seen in association with illness.

Both alterations in the leucogram and also the presence of stress hyperglycaemia may complicate the interpretation of laboratory data in cats. Stress hyperglycaemia in particular can confound both the diagnosis and the management of diabetes mellitus in cats. Cats prone to stress hyperglycaemia may be very difficult to assess in the clinic situation and response to exogenous insulin in diabetics may be difficult to interpret, with some cats appearing insulin-resistant. Testing of blood glucose concentrations in the home environment may help to overcome this (Reusch et al 2006).

Stress responses may also contribute to difficulties in interpretation of adrenal function testing in cats. The response to both ACTH stimulation tests and dexamethasone screening tests is known to be very variable with some normal cats showing either escape from dexamethasone suppression and/or high responses to ACTH (Hoenig 2002), and results of the urine cortisol:creatinine ratio screening test may become elevated in hospitalised cats (Cauvin et al 2003).
Another anomaly that may occur in cats as a result of stress, is transient and intermittent alkaluria (Buffington & Chew 1996). This may confound the interpretation of urine pH in cats, especially after an acute stress event such as a journey to a veterinary clinic. Alkaluria may be present, perhaps caused by stress-induced hyperventilation, when in fact the urine pH may be acidic when the cat is not affected by acute stress in the home environment.

Effect of stress in the clinic – hospitalisation:
Hospitalisation of cats is frequently needed in veterinary clinics, but can be a very stressful experience for many cats. This can result in many behavioural changes including overt displays of fear and aggression, in the cat becoming withdrawn from its surroundings, and may be a significant contributor to inappetence or anorexia in a hospitalised patient.

Having a low-stress environment is critically important in helping to manage the inappetent and anorexic cat in the clinic (Delaney 2006). Many aspects need to be considered in attempts to reduce stress, and these should include:

- Having a quiet, cat-only hospitalisation ward where possible
- Having a quiet secluded area in the clinic where particularly stressed cats can be hospitalised
- Ensuring the cages are clean, have comfortable bedding and are free from offensive odours
- Ensuring cats are not able to see each other, and can easily hide away from sight
- Ensuring there is sufficient space in the hospitalisation cage for sleeping/resting areas, a litter tray and for food and water bowls, ideally without having bowls and litter trays adjacent to each other
- Offering palatable food from appropriate bowls (ideally low-sided ceramic bowls)
- Avoid 24-hour lighting and maintain light-dark cycles

Human-cat interaction is also vital for the hospitalised cat. If the cat is only handled for procedures, it is likely to increase the perception of stress and fear. Having someone

offering food who is also spending time interacting with the cat in a non-clinical manner is important – this may include the owner, nurse or other clinical assistant staff (Delaney 2006)

Two well-conducted controlled studies have also evaluated the effect of synthetic feline facial pheromone (FFP) manner on the demeanour and/or food intake of cats in a hospital situation.

One study involved pre-anaesthetic medication and assessment of 77 cats in a busy hospital environment (Kronen et al 2006) and evaluated the use of FFP in the hospital cage, in addition to other pre-medication drugs. Cats were carefully evaluated looking at defined facial features and body postures to assess stress responses. The results indicated that using a combination of acetyl promazine (ACP) and FFP produced a significant calmer cat than using ACP alone (or FFP alone). The results showed that FFP had additional calming effects in cats given ACP and to a lesser extent, also in cats not given ACP.

A second study (Griffiths et al 2000) evaluated the effect of using FFP in cat cages prior to hospitalising cats. They found that the use of FFP in the cage prior to hospitalisation was associated with significant increases in grooming behaviour and interest in food, more lying and sitting behaviour and less sleeping. In a second part to that study, they also found that placing a cat carrier within the cage, so that the cat had an opportunity to hide in it or lay on top of it produced even further benefit with an increase in food intake being documented.

Together, these results emphasise that the hospitalisation conditions can have a profound effect on cats, and that using FFP can also help improve measureable effects of stress.

Effect of stress on the manifestation of clinical disease:
A final but important aspect of feline stress is its effect on the manifestation of signs of clinical disease. There is a long-standing and well-established strong link between feline stress and feline idiopathic cystitis (FIC).

Cats with FIC appear to have underlying neurohormonal abnormalities that parallel humans with type 1 interstitial cystitis. Cats have been shown to have increased concentrations of catecholamines, CRF and ACTH, all consistent with an activated stress response. However, their adrenal glands are smaller than healthy cats and they have blunted cortisol responses to ACTH suggesting uncoupling of the normal stress response and adrenal insufficiency or reduced adrenal reserve (Buffington 2004).
It is hypothesised that chronic stress, neurohormonal abnormalities and increased catecholamine release may be a primary causal factor in the development of FIC (and in humans with interstitial cystitis), but if that is the case, it might be expected that FIC would not necessarily be the only manifestation of disease. The combination of clinical signs referable to other body systems (eg, skin, respiratory tract, gastrointestinal tract) along with signs of FIC, the observation that the signs wax and wane in severity, and that they respond favourably to environmental enrichment has been used as the basis for the identification of a broader disease category that has been called 'Pandora syndrome' (Buffington 2011). Cats with FIC have been observed to suffer from a variety of co-morbid diseases that are not necessarily observed in cats with other lower urinary tract disorders. These include behavioural, cardiovascular, endocrine, gastrointestinal and respiratory problems (Buffington et al 2006, Buffington 2011, Stella et al 2011).

Results of two studies are worth noting in this respect. One study looked at the relationship between stress in cats in an animal shelter and the development of signs of disease (Tanaka et al 2012). This study evaluated stress scores in the cats during their first seven days in the shelter and showed a strong negative association between stress scores and food intake, but in addition a strong and significant association between stress scores and the development of upper respiratory infections. While not a manifestation of the 'Pandora syndrome', this study highlighted the potential negative impact of stress on the development of systemic disease, and is likely to have important implications within the clinic as well as within rescue shelters.

A second study specifically investigated the effect of multimodal environmental enrichment on a group of 46 cats with FIC, most of which had severe and frequently recurrent clinical signs. Owners of the cats with FIC wee carefully interviewed and

provided with information about how they could change aspects of the cat's lifestyle and environment to help reduce potential stressor events. Common changes included:

- Increasing the time the owner spent interacting with the cat
- Changing to a canned rather than dry diet
- Increasing the litter box number
- Changing the litter box location
- Cleaning the litter box more regularly
- Reducing inter-cat conflict

The results of the study showed a very marked and significant decrease in the frequency of signs of FIC during the course of the study, but interestingly there was also a significant decrease in perceived fear in the cats, a significant decrease in signs of nervousness, and additionally a significant decrease in signs of respiratory tract disease. This study helps confirm the association between stress and FIC but also demonstrates the association with other medical conditions and that appropriate interventions can improve these signs.

Conclusion

Stress and distress are common in domestic cats for a wide range of reasons, but often as a result of the environment in which they are being kept. This is even more true in the veterinary clinic. We are becoming increasingly aware of the both the physiological and pathological consequences of that stress and how it can contribute to different disease processes, and the importance of managing stress (and distress) in order to minimise its impact and improve the quality of life for feline patients.

References

- Belew AM, Barlett T, Brown SA. Evaluation of the White-Coat Effect in Cats. Vet Intern Med 1999; 13:134–142
- Buffington CA, Chew DJ. Intermittent alkaline urine in a cat fed an acidifying diet. J Am Vet Med Assoc 1996; 209(1):103-4
- Buffington CA, Westropp JL, Chew DJ, Bolus RR. Clinical evaluation of multimodal environmental modification (MEMO) in the management of cats with idiopathic cystitis. J Feline Med Surg 2006; 8(4):261-8
- Buffington CAT. Comorbidity of interstitial cystitis with other unexplained clinical conditions. J Urology 2004; 172:1242-1248
- Buffington CA, Westropp JL, Chew DJ, Bolus RR. Risk factors associated with clinical signs of lower urinary tract disease in indoor-housed cats. J Am Vet Med Assoc 2006; 228(5):722-5
- Buffington CAT. Idiopathic cystitis in domestic cats – beyond the lower urinary tract. J Vet Intern Med 2011; 25:784-796
- Cauvin AL, Witt AL, Groves E, Neiger R, Martinez T, Church DB. The urinary corticoid: Creatinine ratio (UCCR) in healthy cats undergoing hospitalisation. J Feline Med Surg 2003; 5: 329-333
- Delaney SJ. Management of anorexia in dogs and cats. Vet Clin Small Anim 2006; 36:1243-1249
- Feldhahn JR, Rand JS, Kinnaird E. The effect of interday variation and a short-term stressor on insulin sensitivity in clinically normal cats. J Feline Med Surg. 1999; 1(4):233-40
- Hoenig M. Feline hyperadrenocorticism — where are we now? J Feline Med Surg 2002; 4:171-174
- Laluha P, Gerber B, Laluhová D, Boretti FS, Reusch CE. Stress hyperglycemia in sick cats: a retrospective study over 4 years. Schweiz Arch Tierheilkd. 2004; 146(8):375-83
- Leidinger K, Nolte I, Eigenbrodt E. Klinische und labordiagnostiche untersuchungen zum pahnomen der hyperglykamie der katze. Kleintierpraxis 1989; 34:457-464
- Levine ED. Feline fear and anxiety. Vet Clin Small Anim 2008; 38:1065-1079
- Opitz, M. Stress hyperglycemia in cats. Berl Munch Tierarztl Wochenschr 1980; 103(5):151-8.
- Quimby JM, Smith ML, Lunn KF. Evaluation of the Effects of Hospital Visit Stress on Physiologic Parameters in the Cat. Journal of Feline Medicine and Surgery 2011; 13: 733
- Reusch CE, Kley S, Casella M. Home monitoring of the diabetic cat. J Feline Med Surg 2006; 8:119-127
- Sparkes AH, Caney SMA, King MCA, Gruffydd-Jones TJ. Inter- and intraindividual variation in Doppler ultrasonic indirect blood pressure measurement in healthy cats. J Vet Intern Med 1999; 13:314-318
- Stella JL, Lord LK, Buffington CA. Sickness behaviors in response to unusual external events in healthy cats and cats with feline interstitial cystitis. J Am Vet Med Assoc 2011; 238(1):67-73
- Tanaka A, Wagner DC, Kass PH, Hurley KF. Associations among weight loss, stress, and upper respiratory tract infection in shelter cats. J Am Vet Med Assoc 2012; 240(5):570-6