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Acute kidney injury

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Hello and happy new year! We are into 2017 with a blast and an issue filled with useful articles!

We begin with Natalie Finch’s informative article on acute kidney injury. This condition is frequently caused by toxins such as lilies or antifreeze, but other causes such as ureteroliths and infections should not be overlooked. In the next article, Liz Jefferson explains what makes her clinic ‘cat friendly’, and shows how practical steps can be taken in first opinion practice to improve the handling of cats. Laura George then tells us how to triage a feline trauma patient, a stressful presentation that requires a logical approach.

Finally, although more associated with dogs, Nicola Bates from the Veterinary Poisons Information Service discusses which human foods are toxic to cats. Some cats, mine included, do like to raid the fridge and are vulnerable to illness caused by various foodstuffs.

We start a new series of webinars this month, focusing on practical nursing topics — we hope you will join us for some great speakers throughout the year.

Best wishes,

Sam Taylor, Veterinary Editor

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*Source: Mills 2001. Evaluation of a novel method for delivering a synthetic analogue of feline facial pheromone (Feliway®) to control urine spraying by cats.
Acute kidney injury in cats

Acute kidney injury (AKI) in cats includes a spectrum of insult and injury that can result in acute renal failure or can be clinically undetectable. Common aetiologies include ureteral obstruction, pyelonephritis and nephrotoxin exposure. Acute on chronic episodes can also occur in cats with pre-existing chronic kidney disease. Diagnosis is based on blood and urine testing. Management includes maintaining renal perfusion, oxygen delivery and urine output, addressing any secondary complications and treating underlying causes. The prognosis for AKI is guarded and approximately 50% of cats that survive will have persistent chronic kidney disease post-recovery.

Acute kidney injury (AKI) is characterised by sudden onset renal parenchymal injury which can be clinically undetectable or can result in generalised failure of renal function; i.e., acute renal failure (ARF). The term AKI has now replaced ARF as it is recognised that there can be a spectrum of insult and injury to the kidneys without failure and that injury, which may not necessarily result in failure, can be of great clinical significance.

Classification schemes for AKI

The most widely used classification schemes for AKI in human medicine are the Risk, Injury, Failure, Loss of kidney function and End-stage kidney disease (RIFLE) and Acute Kidney Injury Network (AKIN) schemes. Studies to evaluate these schemes have been performed in veterinary patients and a grading system has been proposed by the International Renal Interest Society (IRIS) to better define criteria for AKI in cats and dogs (see page 5).

AKI leads to accumulation of uraemic toxins, fluid and electrolyte dysregulation and acid-base imbalances. It is associated with high rates of morbidity and mortality.

Four phases of AKI are currently recognised:
- initiation;
- progression;
- maintenance; and
- recovery.

Figure 1 illustrates the processes occurring at each phase.

Natalie Finch
BVSc PhD DipECVIM-CA MRCVS

Following graduation from the University of Liverpool, UK, in 2005, and a period in practice, Natalie Finch was awarded a PhD at the Royal Veterinary College, UK, for researching chronic kidney disease in 2011. She then joined the Feline Centre at the University of Bristol, UK, as the International Cat Care Senior Clinical Training Scholar in Feline Medicine. In 2014, Natalie commenced a clinical postdoctoral fellowship sponsored by the Wellcome Trust at the Academic Renal Unit, University of Bristol and in 2016 she passed her European Diploma in Internal Medicine.
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**Aetiology**
Historically AKI in cats was most commonly associated with nephrotoxin exposure,¹ (e.g., lilies or ethylene glycol) but this data was from a US referral population and may not reflect other countries or first opinion practice. Ureteral obstruction is increasingly recognised as a significant cause of AKI in cats affecting up to 35% in a referral population of cats.²

*Key point*
Although several toxins cause AKI in cats, other causes, such as ureteral obstruction and pyelonephritis, may be more common in first opinion practice.

**Acute on chronic AKI**
Some cases of AKI can be superimposed on pre-existing chronic kidney disease (CKD) which is termed ‘acute on chronic’. This is important to recognise clinically as staging and management will be different than that for CKD. Acute on chronic episodes can occur as a complication of CKD, and also as a result of uretero- or nephroliths causing obstruction.

AKI can be considered to be pre-renal, intrinsic renal or post-renal in origin.

**Pre-renal AKI**
Pre-renal injury results from a functional decline in glomerular filtration rate (GFR) secondary to reduced renal blood flow (RBF) or perfusion pressure. Pre-renal AKI is consequently the result of clinical conditions that disrupt the extracellular fluid volume or systemic or renal haemodynamics, such as hypovolaemia, hypotension, reduced cardiac output or administration of angiotensin converting enzyme (ACE) inhibitors. The kidneys are particularly susceptible to ischaemic damage. In normal patients the renal cortex receives most of the RBF (making it susceptible to toxins), but medullary blood flow is approximately 10–15% of RBF, meaning this area is first affected by ischaemia and hypoxia.

**Intrinsic renal AKI**
Intrinsic renal AKI is associated with renal damage and morphological changes within the renal tissue. This may result from prolonged ischaemia, immune-mediated disease, infectious disease, systemic
disease such as pancreatitis, systemic inflammatory response syndrome or nephrotoxins (Figure 2). The most common nephrotoxins in cats are considered to be ethylene glycol, lilies and non-steroidal anti-inflammatory drugs (NSAIDs) (see box).

**Post-renal AKI**
Post-renal AKI is caused by urinary tract obstruction such as urethral or ureteral calculi, severe pyelonephritis, neoplasia or urinary tract rupture and reabsorption of uraemic toxins. This will result in increased glomerular back pressure and hence reduction in GFR.

**Non-steroidal anti-inflammatory drugs and renal function**
Non steroidal anti-inflammatory drugs (NSAIDs) inhibit cyclooxygenase (COX), which catalyses the formation of prostaglandins and thromboxane from arachidonic acid. Prostaglandins maintain renal blood flow and hence glomerular perfusion and GFR. In normal healthy patients there is low potential for nephrotoxicity. However, when renal blood flow is decreased, for example in anaesthesia, hypovolaemia or hypotension, then renal function is more dependent on prostaglandin synthesis. Careful use of NSAIDs in patients that are normotensive and have no fluid volume deficits should avoid renal complications.
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typical of this condition and weight loss and poor body condition should raise concerns of acute on chronic renal disease.

A complete and thorough physical examination should be performed in each patient, including assessment of hydration, cardiovascular and respiratory status. AKI patients can have fluid volume overload which may manifest as conjunctival oedema, peripheral oedema, pleural effusion, pulmonary oedema or, potentially if very severe, hypertension. Lung auscultation and respiratory rate can be helpful if there is a suspicion of pulmonary oedema or pleural effusion. Jugular distension or pulsation can also be assessed. Conversely, patients can be dehydrated secondarily to vomiting and anorexia. Bradycardia or other dysrhythmias can be noted if patients are hyperkalaemic. The urinary bladder should be palpated to ascertain if there is evidence of urine production. This should be assessed in conjunction with hydration status. Neurological examination and assessment of mental status can be helpful in detecting uraemic or hypertensive encephalopathy. Renal palpation should be performed to detect changes or asymmetry in kidney size and also to assess if there is any pain. Oral examination can reveal oral ulceration or uraemic stomatitis, and identification of pollen on a cat’s coat may suggest lily exposure.

Laboratory testing
Haematology may demonstrate anaemia or neutrophilia, but is generally non-specific. If there is moderate-to-severe anaemia present (with no obvious cause such as trauma or haemorrhage), then pre-existing CKD may be suspected. Biochemistry will allow assessment of the severity of the azotaemia, identify other underlying or concurrent diseases, and allow electrolyte abnormalities to be identified. Hyperkalaemia is important to identify and treat, for example, and hypocalcaemia may indicate ethylene glycol toxicity. Further testing such as acid-base analysis may also be indicated.

Urinalysis is important, ideally prior to fluid therapy, to allow measurement of urine specific gravity (USG). This will assist in determining whether the azotaemia is pre-renal in origin and potentially fluid volume responsive. Urine culture should also be performed to exclude potential bacterial pathogens (eg, leading to pyelonephritis), and urine sediment examination may be helpful in identifying an active sediment and for assessing the presence of casts which suggest tubular damage (Figure 3). Other changes on urinalysis can include proteinuria,
Grading of acute kidney injury

The IRIS staging system for CKD is based on serum or plasma creatinine concentration, with substaging based on proteinuria and systolic blood pressure (see http://www.iris-kidney.com/pdf/staging-of-ckd.pdf). Recently a grading system for AKI has been proposed by IRIS for dogs and cats (Table 1) and see http://www.iris-kidney.com/pdf/grading-of-acute-kidney-injury.pdf. This is predominantly based on creatinine concentration and urine output. The aim of the IRIS AKI grading system is similar to that of the CKD staging system which is to aid in early recognition, diagnosis, management and prognosis of patients. An important difference between the two systems is that the AKI system can be used in patients with unstable kidney disease, whereas the CKD system is only applied to patients with stable disease.

Each AKI grade is subgraded based on whether the patient is oligoanuric (oliguria <1 ml/kg/h urine production, anuric 0 ml/kg/h over 6 h), non-oliguric (>1 ml/kg/h) or requires renal replacement therapy (RRT). Urine production is important in the subgrading of AKI patients due to its significance in therapeutics and outcome.

Table 1: IRIS AKI grading system

<table>
<thead>
<tr>
<th>Grade</th>
<th>Serum creatinine concentration (μmol/l)</th>
<th>Clinical description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>&lt;140</td>
<td>Non-azotaemic AKI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Documented AKI: historical, clinical, laboratory or imaging evidence of AKI, clinical oliguria/anuria, fluid volume responsive (increase in urine production &gt;1 ml/kg/h within 6 h or decrease in blood creatinine concentration to baseline over 48 h) and/or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Progressive non-azotaemic increase in creatinine concentration &gt;26 μmol/l within 48 h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Documented oliguria (&lt;1 ml/kg/h) or anuria over 6 h</td>
</tr>
<tr>
<td>II</td>
<td>141–220</td>
<td>Mild AKI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Documented AKI and static or progressive azotaemia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Progressive azotaemia (increase in creatinine concentration &gt;26 μmol/l within 48 h; this may include cats with pre-existing CKD) or fluid volume responsiveness (increase in urine production &gt;1 ml/kg/h within 6 h or decrease in blood creatinine concentration to baseline over 48 h)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Documented oliguria (&lt;1 ml/kg/h) or anuria over 6 h</td>
</tr>
<tr>
<td>III</td>
<td>221–439</td>
<td>Moderate to severe AKI</td>
</tr>
<tr>
<td>IV</td>
<td>440–880</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>&gt;880</td>
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glucosuria and the presence of calcium oxalate monohydrate crystals in cats with ethylene glycol toxicity. Glucosuria can result from acute tubular necrosis and proteinuria from tubular leakage or necrosis of tubular epithelial cells.

Diagnostic imaging
Radiography and ultrasonography may help identify an underlying cause of the AKI, and assessing renal and bladder size. Urinary calculi may be seen, and renomegaly may indicate conditions such as renal lymphoma, or ureteral obstruction causing hydronephrosis.

Management of AKI
The management goal of AKI is first, to prevent further renal damage by identifying and treating any primary underlying cause appropriately, and second, to enhance renal cellular recovery. Figure 4 summarises the general management of AKI in cats. Potentially treatable underlying diseases include pyelonephritis, urinary tract obstruction or lymphoma. If the cat has a known very recent history of toxin ingestion, then inducing emesis or the administration of activated charcoal as an absorbent may be beneficial. Consultation with a veterinary poisons service is recommended. Specific treatment of ethylene glycol toxicity is discussed in detail in a previous article (Ethylene glycol poisoning. Feline Focus 2016; 1 [11]: 401-407).

Fluid therapy
Fluid volume status should be addressed first and foremost. AKI patients can range from dehydrated or hypovolaemic to fluid volume

Key point
The key management strategies for AKI patients include:
- maintaining renal perfusion and oxygen delivery;
- maintaining urine output; and
- addressing secondary complications of AKI.

Figure 4: General approach to AKI in cats

6 icatcare.org/felinefocus
overloaded. Dehydrated or hypovolaemic patients should receive appropriate fluid administration to correct any deficit and become volume replete. Dehydration or hypovolaemia can result in reduced RBF and consequently decreased GFR and urine formation and contribute to further renal injury. In patients with pre-renal AKI, the changes are potentially reversible if the haemodynamic abnormalities are identified and corrected quickly.

Care must be taken with fluid administration as overzealous fluid administration can result in fluid volume overload, particularly in oliguric or anuric patients. Drip pumps and syringe drivers are invaluable for delivering accurate fluid volumes to cats (Figure 5).

Fluid therapy is also important in correcting electrolyte imbalance and acid-base disorders. Compound sodium lactate (Hartmann’s, Lactated Ringer’s) is appropriate in most cases. Fluid resuscitation in hypovolaemic or hypotensive cats should involve a fluid bolus of 10–15 ml/kg administered over 10–20 mins. The cat should then be reassessed and boluses repeated until the cat becomes haemodynamically stable.

Ongoing fluid rates should take into account fluid losses such as urine output, vomiting or diarrhoea. In anuric patients, fluid rates should be carefully considered and it is recommended to replace insensible losses (respiration and faeces) only which are approximately 22 ml/kg/day.

An initial period of polyuria and solute diuresis occurs in the early recovery stages of AKI. This can be challenging to manage as large volumes of intravenous fluids are required and there may be significant electrolyte losses resulting particularly in hypokalaemia.

Once the patient becomes stable and the azotaemia has either resolved or stabilised, fluid therapy can be gradually tapered ensuring there is a corresponding decrease in urine output and no increase in creatinine concentration.

**Monitoring urine output**

Urine output should be monitored as accurately as possible, particularly in response to fluid therapy. This should, ideally, be achieved by placement of a urinary catheter and
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a closed collection system (easily achieved with short anaesthesia in both male and female cats). Urinary catheter placement without a collection system should be avoided due to the risk of development of urinary tract infection. If placement of a urinary catheter is not possible then collecting and weighing naturally voided urine can provide some estimate (1 g = 1 ml), as can measurement of urine in the bladder using ultrasound. Normal urine output in a healthy animal not on fluid therapy would be 1-2 ml/kg/h. Oliguria is defined as urine production <1 ml/kg/h and anuria as zero urine production. The catheter should be removed once normal urine output is achieved.

Hyperkalaemia

Hyperkalaemia is perhaps the most common secondary complication of AKI and results from decreased renal excretion of the cation. Severe hyperkalaemia (>6 mmol/l) can result in cardiac arrhythmias, most commonly recognised as bradyarrhythmias. ECG monitoring is helpful for detection of arrhythmias. Typical ECG changes include prolonged QT interval, widened QRS complex and small or absent P waves. Severe life-threatening hyperkalaemia can be managed with calcium gluconate, dextrose and/or insulin, sodium bicarbonate and in rare cases with beta agonists. Calcium gluconate will not decrease the potassium concentration but will alter the membrane potential of cardiac myocytes, therefore offering cardioprotection.

Acid-base status

Metabolic acidosis is frequently recognised in AKI patients due to reduced bicarbonate production in the kidneys, reduced ability to excrete hydrogen ions and an increased concentration of uraemic acids. Management of metabolic acidosis should focus on correcting fluid abnormalities and hypoperfusion which may be contributing to lactic acidosis. Sodium bicarbonate should only be reserved for severe acidosis (pH <7.1) and when a patient is volume replete. It should not be used if the cat is hypocalcaemic.

Hypertension

Many cats with AKI develop hypertension, with a recent study reporting 38% of cats to have a systolic blood pressure >150 mmHg.² Systolic blood pressure should be measured using the Doppler technique. If hypertension is documented, then anti-hypertensive medication starting with amloptine should be instigated. Angiotensin converting enzyme (ACE) inhibitors should be avoided due to their ability to cause afferent arteriolar constriction and further reduce RBF. Conversely, hypotension (systolic blood pressure <80 mmHg) should also be avoided to prevent further renal hypoperfusion and damage.

Gastrointestinal signs

Gastrointestinal signs, and in particular vomiting, are common in AKI patients. Vomiting may result from the direct effects of uraemic toxins on the chemoreceptor trigger zone causing a central nausea, uraemic gastritis/ulceration, delayed gastric emptying/ileus, reduced renal clearance of gastrin leading to increased hydrochloric acid secretion or gastrointestinal oedema. Management should include the administration of antiemetics such as

Tip

If there is an active sediment on urinalysis or suspicion of pyelonephritis, then it may be prudent to start broad-spectrum antibiotics pending culture and sensitivity.
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**Nutrition**

Nutritional support should be considered in cats with AKI as they are generally anorexic and in a catabolic state. The placement of a feeding tube may be required. A naso-oesophageal feeding tube may be most appropriate (Figure 6) as it can be placed with ease in a conscious patient negating the need for general anaesthesia. The placement of a feeding tube can also facilitate the administration of medications and fluids. Ideally, a renal diet that is both protein and phosphate restricted should be fed, although diet choice may be limited by tube diameter. Oral phosphate binders can also be used in hyperphosphataemic patients.

![Figure 6: Early nutrition should be provided and a naso-oesophageal feeding tube is straightforward to place](image)

Other treatments

Diuretic therapy

If a patient remains oligoanuric despite fluid therapy, then conversion to a non-oliguric state can be attempted with the use of diuretics. In human medicine, dialysis is used in preference to diuretics. There are risks of worsening kidney injury, or cardiovascular side effects associated with some agents. The use of diuretics should not be applied indiscriminately and careful risk-benefit assessment should be made before their use. Furosemide is the drug of choice to promote diuresis and an increase in urine output should be seen between 20 and 60 mins after intravenous administration. The diuretic effects of furosemide may also be beneficial in some patients in preventing fluid volume overload. Clinical studies evaluating the use of furosemide in cats with AKI are lacking. Other diuretics occasionally used include mannitol and dopamine.

Renal replacement therapy (RRT)

RRT encompasses different forms of dialysis which can be used to manage patients in renal failure. It is generally indicated only for those patients expected to regain renal function, such as toxicity cases. The principles of dialysis are that fluid and solutes can be transported across a semipermeable membrane and urea, creatinine, potassium, calcium and phosphate can move down a solute gradient into the dialysate (Figure 7). RRT is not widely available and veterinary schools or large referral clinics should be consulted for advice. Peritoneal dialysis is labour intensive and associated with many complications. Peritoneal dialysis involves placement of a peritoneal catheter through which there is infusion of dialysate which is allowed to remain in the peritoneal cavity for a set period of time before being removed.

Monitoring

Accurate monitoring of urine output in the AKI patient should form a key part of the management approach. Monitoring of hydration status is also essential.
Monitoring of hydration status should include assessment of:
• skin turgor;
• body weight;
• respiratory rate and lung auscultation;
• packed cell volume/total solids;
• urinary output; and
• blood pressure.

Electrolytes, renal markers and blood pressure should be monitored regularly, and if possible acid-base balance.

Pulmonary compromise can occur in AKI patients. Contributory factors include fluid volume overload, aspiration pneumonia and uraemic pneumonitis. Monitoring of respiration rate and regular thoracic auscultation may be helpful in detecting development of respiratory problems. Oxygen saturation status (using a pulse oximeter or blood gas analysis) should also be assessed regularly if possible.

**Prognosis**

Urine output, and specifically a non-oliguric state, has been shown to be an important prognostic indicator in cats with AKI.¹ A recent study reported the mortality rate at 20 days to be 64% in cats with AKI.³ Negative prognostic indicators in this study were low body temperature, low albumin concentration and low lactate dehydrogenase (LDH) activity. An earlier study reported a mortality rate of 47% in cats; however, this was a referral population and mortality rates may be higher in general practice.¹ Potassium was an important prognostic indicator in this study with each unit increase in potassium associated with a 57% decrease in survival. The prognosis is generally considered to be better for patients with AKI in which the tubular basement membrane is preserved. Mortality rates in cats following lily ingestion is reported to be between 50 and 100%.⁴

Patients with early stage AKI (IRIS grades I and II) may regain adequate renal function after several days; however, those in the more advanced stages may require several weeks of hospitalisation and supportive care or may die despite treatment. Full renal recovery for cats with severe AKI may take several months. The

**Key point**

Creatinine is not a prognostic indicator in cats with AKI (cats with very high creatinine levels can recover); however, hyperkalaemia and oliguria or anuria may indicate a poorer prognosis.
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mortality rate increases and prognosis worsens in cats with increasing stage of AKI.\(^5\) However, other studies have reported no association between survival and degree of azotaemia.\(^1-3\) Specifically, in post-renal AKI there is no association between severity of azotaemia and outcome and therefore the prognosis following appropriate management is fair. In cats that survive AKI, there is a high prevalence (approximately 50%) of persistent CKD post-recovery.\(^1\)

Conclusions
AKI in cats can be treated successfully, but the prognosis is guarded. Removal of the underlying cause and accurate fluid therapy are vital, along with management of other complications. Level of azotaemia may not be associated with prognosis, but intensive treatment may be required.

References

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A closer look at...

Being cat friendly in everyday practice

It is well recognised that, because of their unique nature and needs, taking a cat to a veterinary clinic can be very stressful, both for the cat and also the owner. The Cat Friendly Clinic programme, run by the International Society of Feline Medicine, is designed to help address these issues. The scheme aims to create more cat friendly veterinary clinics and so reduce the stress for the cat, making veterinary visits easier for cat owners as well. Here, Liz Jefferson provides a personal view of what being cat friendly means to her and how it has been achieved in her practice.

Liz Jefferson started working at Blacks Vets, UK, in August 1996 as a student veterinary nurse. She completed a NVQ in animal care in 1997, passed her Royal College of Veterinary Surgeons (RCVS) pre-veterinary nursing examination in 1998 and immediately enrolled on the RCVS course for veterinary nursing. She qualified as a registered veterinary nurse in 2003. She became head nurse of the second biggest branch practice at Blacks Vets and was promoted to branch manager in 2013. She is particularly interested in feline medicine, feline nursing and emergency and critical care.

Cats are very individual pets and definitely have their own ways. It’s an old veterinary saying that cats are not small dogs — and they really aren’t! In particular, cats react very differently to new surroundings and new people. My saying is ‘they own you, you don’t own them’. Basically, cats just like to be in charge.

In my view, being cat friendly means a great deal more than just having a certificate placed on the wall. I am very passionate about cats and how they are treated and handled throughout the veterinary working day.

What the ‘Cat Friendly Clinic’ certificate does show is that our practice understands that cats are different and that they need to be treated and handled accordingly. They have different needs, require different ways of being handled, and they get presented to the clinic with many feline-specific illnesses, resulting in completely different treatment plans.

But what does being a Cat Friendly Clinic actually mean?
Cat Friendly Clinic (CFC) is an accreditation scheme developed by the International Society of Feline Medicine (the veterinary division of the charity International Cat Care). It has changed the way in which cats

Key point
Do your receptionists understand what it means to be a CFC? They are the first contact owners have with the clinic; make sure they are telling clients you care about cats and are advising them appropriately.
A closer look at...

Figure 1: The ISFM Cat Friendly Clinic scheme is relaunching in 2017 with six new official sponsors. See www.catfriendlyclinic.org

are treated in veterinary clinics. Being cat friendly means exactly what it says; we have met lengthy criteria to be officially recognised as a CFC by the International Society of Feline Medicine (Figure 1).

CFC accreditation shows clients we understand the needs of their cats and have special equipment and more calming ways to treat cats. To clients, pets are part of the family and loved very dearly, so the cats in our care are treated as if they are our own.

What do we do as a Cat Friendly Clinic?

When cat clients ring the surgery
Our experienced staff have been trained to talk to clients about what it means to be cat friendly — that is, we treat cats differently at our surgery. This includes information about:

- What being a silver CFC practice actually means.
- Helping clients introduce their cats to their carriers to help smooth the journey to the surgery. (Studies have shown that 60% of owners recognise their cats get stressed going to the vet and nearly 40% of owners get stressed just at the thought of a veterinary visit).
- Booking appointments for nervous cats at a quieter time of day. This could be at the start or end of the day or when lots of cat appointments are booked together.
- Using the CFC information sheets (see www.icatcare.org/catfriendlyclinic/client-leaflets), emailing or posting them to both new and old clients, and using the information when talking on the phone, giving advice on getting your cat into the carrier, and so on.

When clients enter the surgery with their cat

- All clients and their cats are directed to the cat-only waiting area (Figure 2).
- Clients are encouraged to place cat carriers on the chairs next to them, on top of the desk when talking to receptionists, or on the reception ‘cat parking’ table, rather than on the floor.
- Large towels are given to clients who have very nervous cats, or if the waiting room is busy, to place over the carrier so cats feel secure, hidden and can’t see the rest of the waiting area and its inhabitants.
- If the reception area becomes too...
busy or noisy, very nervous cats may be placed into a separate room or our separate waiting area to wait for their appointment.

- The cat-only area has CFC information leaflets and cat magazines for clients to read while waiting for their appointment. There are also notice boards with information about our CFC status (Figure 3), the practice cat advocate nurse, and on common diseases or seasonal threats, such as antifreeze, lily toxicity and kidney disease.
- When clients leave the surgery, they are given literature about giving cats medication if their pet is sent home with any tablets or other medication (Figure 4).

**Tip**
While taking a history from the client, the carrier door should be opened to allow the cat to explore the room if it wishes to.

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**When cats see our vets**
- Cats are placed onto the vet’s examination table still in their carrier. The carrier door is opened and the cat is allowed to come out of its own free will, during which time the vet talks to the client about their visit.
- Towels pre-sprayed with Feliway (CEVA) are placed on the consult table in front of the opened carrier to help the cat feel more at ease, and prevent it feeling startled by the cold aluminium/plastic examination table.
- For top-opening carriers, cats are gently supported and lifted from their carrier onto the towel by their owners.
- If cats are really reluctant to come out of their carrier (particularly the front-loading variety), the carrier is very subtly tilted to encourage the cat to place its front paws onto the towel, and then the carrier very gently moved away.
- Cats are allowed to roam the consulting rooms as necessary to make them feel at ease while the vet is talking to their owners.
A closer look at...

- As cats may be roaming free on the floor, signs on the doors of vets’ rooms state when cats are in consultation, to ensure no other member of staff walks into the room.
- Small or paediatric stethoscopes are used on cats when auscultating the chest/heart. This reduces stress as the stethoscope head is much smaller and fits more comfortably under their left or right elbow area. It also allows for more accurate auscultation.
- When examination of the cat takes place, and depending on the cat, constant soft stroking and gentle talking can help to reduce stress.
- Injections are normally drawn up with a 21 g (green) needle and this is then changed for a 23 g (blue) needle for administering the subcutaneous injection.
- Accurate weights are recorded, using small scales in the consulting room (Figure 5).

Cat hospital wards
The ward is specifically designed for cats only and includes the following:
- Cages are medium-sized and do not face each other; this prevents stress from cats seeing each other and also reduces the risk of contamination between cats.
- Each cage has a soft Vetbed that has been sprayed with Feliway, a dark ‘hidey box’ and a litter tray. Allowing the cat to hide makes it feel more secure.
- If a cat is very nervous, dark towels are placed over the entire cage door.
- We have different types of litter available to encourage cats to use the litter trays. Some cats prefer the grey gravel type as opposed to wood pellets, for example.
- Shallow litter trays are used to make it easier for cats to get in and out of the trays, especially if they are elderly and arthritic or have IV infusion sets connected.
- Feliway diffusers (CEVA) are used constantly and are changed every month.

Admitting cats
When admitting cats to the hospital, clients are taken away from reception/consulting area into a separate quiet room in the hospital building. This enables the admission process to be quiet and stress-free. This also gives nurses more time to discuss the cat’s needs, its current medication, diet and so on.

Clients are encouraged to view the CFC boarding area if they wish and to place the cat into its accommodation themselves if they prefer.

Figure 5: A set of scales should be kept in the consulting room. This allows accurate recording of the cat’s weight, without using scales that dogs have been weighed on.

Tip
Use ceramic bowls for food and water, to avoid the reflections in stainless steel, and potential tainting of plastic.
• Catnip toys are placed in the cage along with string toys hanging from the inside of the cage doors to encourage cats to play, depending on their age, illness and preferences.
• ‘Quiet’ signs are placed in the cat ward to reduce noise and stress for the cats.
• Ceramic food and water bowls are used as cats generally prefer these to ones made of plastic and metal.

**Tip**

Place a towel previously sprayed with Feliway (CEVA) on the examination or procedures table to provide the cat grip. The towel can be used for gentle restraint. Note that Feliway should be used at least 15 minutes before the towel is needed.

**Nursing and hospital treatment**

There are some general rules in place within the cat ward to keep stress to a minimum for feline patients. These include:

• ‘Quiet’ signs put up in the prep area when cats are being examined or anaesthetised.
• Dogs are never walked past cat cages or allowed to be examined at the same time as cats or in the same room.
• When carrying cats from their cages, nurses are encouraged to hold the animal close to them, their front legs between their fingers of one hand with the other hand supporting the hind legs. This makes cats feel more comfortable and supported when they are being carried.
• Towels may be placed over a cat’s head/body when being carried if it is particularly nervous.
• We use small, quiet clippers when clipping a cat’s leg or neck for venepuncture. These are kept specifically for cats and never used on other species. Clipper noise is very stressful to cats, so the quieter the better.
• Surgical spirit and chlorhexidine scrub are placed onto cotton wool and very gently rubbed onto the skin rather than applying using noisy sprays with strong odours.
• Cats having catheters placed have their leg shaved and EMLA anaesthetic cream applied at least 45 minutes prior to the procedure. The EMLA cream ensures that the cat doesn’t feel any discomfort and keeps completely still for the placement. It is especially helpful in very small and elderly cats. Remember to cover the cream with an occlusive dressing and leave adequate time for it to work.
• Subcutaneous injections are given using a 23 g (blue needle) and intramuscular injections are given using a 25 g (orange) needle.
• Cats are never scruffed when being examined, restrained for general anaesthetics, or for blood samples and other procedures.
• On the prep tables, cats are placed on a towel pre-sprayed with Feliway (CEVA).
• Our general anaesthetic machines

**Our cat friendly venepuncture technique**

For venepuncture, a towel pre-sprayed with Feliway is gently wrapped around the cat’s body to make it feel secure and at ease. Its head is gently held with one hand and raised up. Veterinary nurses or technicians are encouraged to talk quietly to the cats. Occasionally, as a distraction, another nurse will gently stroke the cat’s head during venepuncture so it does not concentrate on what the vet is doing.
A closer look at...

are specifically for cats/small animals under 10 kg.

• Catheters used for cats are 23 g or 25 g only (blue and yellow), depending on the size of the cat.
• Blood samples are taken only with a 25 g (orange) needle unless otherwise indicated.
• All anaesthetised cats have their blood pressure monitored during their procedures. A Doppler blood pressure machine is used (Figure 6).
• A laryngeal scope is used for placement of endotracheal (ET) tubes, to ensure a smooth, accurate and less irritant placement.
• We have multiple ET tubes of different sizes to ensure the correct size is used.
• Micropore (3M) tape is used to hold catheters in place, to ensure easier removal and prevent pulling the fur. Eaze-off Spray (Millpledge Veterinary) is also used, to reduce the stickiness of the bandage for even easier removal.
• After a catheter is removed, Micropore tape is again used so it is easy for clients to remove at home.
• Hospitalised cats wear soft buster collars to reduce stress.
• Cats are gently groomed, stroked and quietly talked to several times during the day to provide reassurance during their stay.
• Nurses are constantly caring for the cats on recovery, checking vital

When a cat is discharged

It is important owners are given enough information before taking their cat home so that the correct level of care can continue. This includes:

• Sending the client home with a detailed discharge sheet that has been specifically tailored for cats only.
• An ISFM Cat Friendly Clinic information sheet about taking your cat home from the surgery and how to give it tablets or eye drops (as appropriate for the cat’s situation — see www.icatcare.org/catfriendlyclinic/client-leaflets).
• Food recovery packs, which are given to all cats on discharge when they have had a general anaesthetic. This light, palatable and highly digestible diet encourages the cat to eat when it gets home.
• We use International Cat Care/ISFM recognised ‘Easy to Give’ medications when we can (see http://icatcare.org/cat-campaigns/easy-give), to help clients cope with giving medicines and increase compliance.

Conclusions

Understanding the differences between cats and other species, and becoming a truly cat friendly clinic forms the basis of a good bond with your patients and, of course, your clients. Trust between clients and the practice is of the utmost importance. I want to ensure that clients are 110 per cent happy. They should know that we have their cats’ interests at heart and that their cats are in the best place for whatever care they need. Becoming an ISFM Cat Friendly Clinic benefits cats, clients and staff.

Figure 6: A Doppler blood pressure monitor is useful for diagnosing hypertension and monitoring blood pressure under anaesthesia
Clinical nursing

Feline trauma patient:
the nurse’s role in triage and management

The veterinary nurse or technician may be the first person to speak to the owner of a cat involved in a trauma, as well as the first to see the cat once it arrives at the clinic. Asking the right questions and preparing appropriate equipment can save time and allow the veterinary surgeon to treat the cat more promptly. Triage should be performed to prioritise the most life-threatening injuries, and should cover the major body systems. General nursing considerations are important following triage, including analgesia, fluid therapy, provision of an appropriate hospital environment and nutrition. Once the patient is stable, further investigations can be performed.

Post-trauma, a cat may present in a variety of different states and the attending veterinary nurse or technician can play an important role in the initial triage and management of the feline trauma patient. The aim of this article is to provide an overview of the aspects a veterinary nurse or technician should be familiar with when managing such a patient.

Initial owner contact
In many cases, the nurse or technician is the first person the owner will speak to in the practice and this is usually by telephone. Telephone triage is a crucial first stage in patient assessment and the nurse or technician must ask concise questions to glean the most useful information from the owner quickly. Questions should be short and simple, bearing in mind that owners will likely be anxious and using medical terminology may stress them further. Box 1 provides example questions. The information that is most important to obtain at this point is:
• whether the condition is an emergency (i.e., the cat needs immediate attention);
• a brief account of the presenting problem;
• the expected time of arrival of the cat to the practice; and
• contact details for the owner.

Tip
Owners will be very anxious when their cat has suffered a trauma. Ask short, simple questions, to establish the cat’s clinical condition and fitness to travel. Avoid medical terminology. Record contact details and an estimated time of arrival.

Laura George
DipHECVN DipAVN (small animal)
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The initial conversation should be short but provide enough information to allow the veterinary team to prepare for the patient’s arrival. Advice on how to transport the cat should also be given; the cat is likely to be scared and potentially in pain so advise the owner to take sensible precautions when handling. For example, wrapping the cat in a towel to pick it up; any obvious injuries should not be touched. To prevent escape a basket should be used to transport the cat but if in pain or obviously injured it may be necessary to use a large box.

If a spinal or neck injury is suspected it is essential to advise the owner to handle the cat carefully to avoid worsening any injury. In these cases it may be preferable for the veterinary surgeon to visit the patient at home.

**Preparation**
Upon completion of the telephone call it is important to alert the veterinary team of the impending arrival of the patient and its condition. Then, emergency equipment can be prepared, including:
- endotracheal tubes of various sizes;
- equipment for providing oxygen support (eg, face mask, oxygen tent);
- suction equipment plugged in and ready;
- equipment for intravenous access, (eg, IV catheters of various sizes);
- emergency drugs (eg, adrenaline, atropine, lidocaine). Most practices have a ‘crash’ or emergency box (Figure 1) containing such drugs and dosage charts;
- intravenous fluids and giving sets (run through);
- stethoscope;
- quick access to bandaging materials for haemorrhaging wounds;
- needles, syringes (various sizes) and blood tubes for emergency tests;
- diagnostic equipment, such as ultrasound or x-ray machines, turned on and warmed up.

**Key point**
The practice emergency or ‘crash’ box, containing emergency medications such as adrenaline and equipment such as ET tubes, should:
- be easily accessible in an emergency;
- checked regularly to ensure contents are in date and present;
- contain a dosage chart for important emergency drugs calculated for various weights of cat.

An emergency is not the time to find out items are missing.
Arrival at the practice
When the cat arrives take it through to a quiet area (eg, a consulting room) where it can be assessed calmly away from noise and other animals. It is also important to introduce yourself to the owners and explain that you intend to examine their pet to determine the emergency treatment required. Reassure the owners that a veterinary surgeon will also examine their pet and speak to them. In an emergency situation it may be acceptable to provide first aid having obtained verbal consent only, but signed consent from the owners, following consultation with the veterinary surgeon must be obtained prior to further investigation and treatment.

Triage
With all patients arriving at the practice it is important to prioritise and determine which have the most life-threatening conditions — this is termed triage. Clinical examination should be performed without stressing the cat further and should cover all major body systems including: respiratory, cardiovascular, neurological and urogenital systems. Any problems with these systems can be life-threatening and should be addressed immediately. Triage will determine the nature of emergency treatment required; any follow-up diagnostic tests and more detailed examination are performed once the cat has been stabilised.

Respiratory system
Assessment of the respiratory system focuses on the presence and degree of hypoxaemia. Reduced tissue oxygenation and prolonged hypoxaemia can lead to organ dysfunction. Airway patency must be immediately assessed and the veterinary nurse or technician should ensure that the patient is

Tip
Dyspnoeic cats are extremely fragile and restraint, or diagnostic tests such as radiography, can significantly worsen their clinical condition. Oxygen supplementation and observation of their breathing pattern should be the first priority.

Key point
Avoiding stress is vital for the feline trauma patient. Excessive handling, exposure to noise or dogs, for example, can precipitate a cardiopulmonary arrest in some situations.

Figure 1: The emergency or ‘crash’ box is essential in every practice
Clinical nursing

actually breathing. Immediate intubation and ventilation is critical if the cat is in respiratory arrest.

**Box 2: Potential causes for abnormal respiratory pattern/effort**

- **paradoxical pattern**: the chest and abdominal walls move in opposite directions, often with a rapid rate. This may indicate pleural space disease but can also be seen with exhaustion of the respiratory muscles in other conditions.
- **prolonged expiratory phase**: seen in cats with bronchial disease such as asthma or pulmonary parenchymal disease such as pneumonia.
- **prolonged inspiratory phase**: usually indicates upper respiratory tract pathology such as laryngeal disease.
- **restrictive pattern**: rapid and shallow breathing, inspiratory and expiratory phases equal, often associated with pleural effusion or pulmonary parenchymal disease; eg, pulmonary oedema.
- **postural changes**: postural adaptations are made to try and maximise space for lung expansion and amount of air taken in; eg, elbow abduction (elbows held out from chest), neck extension and open-mouth breathing (Figure 2).

If any of these changes are observed then extremely careful monitoring is required as the cat may be close to decompensating and deteriorating, requiring rapid intervention.

Respiratory rate (RR) is checked next. Normal feline RR is 10–30 breaths per minute and an increased RR (tachypnoea) can be an indicator of fear, pain, acidosis or respiratory compromise. Alongside respiratory rate, pattern and effort must also be evaluated.

During normal inspiration the thorax and abdomen should move outwards, and during inspiration collapse inwards and forwards. Abnormal patterns include paradoxical movement, prolonged expiratory or inspiratory phases, a restrictive pattern and postural changes. If any of these changes are documented the patient is potentially at the edge of its physiological reserves and close to decompensating. These patients must be closely monitored and oxygen therapy provided with minimal stress. Box 2 provides more information on these abnormal patterns.

Mucous membrane (MM) colour can be checked on the gums, lips or sclera but it may not be possible if the cat is particularly stressed and oxygen dependent. Normal colour is pale pink. Box 3 explains what variations may be seen. It is important to note that if cyanosis (blue MM) is observed then the patient is suffering from severe hypoxaemia and requires immediate oxygen therapy.

Respiratory auscultation should also be performed. Listen for any wheezing or crackles. The absence or reduction of any lung sounds may indicate pleural space disease such as pneumothorax, ruptured diaphragm, pleural effusion or consolidation of lung lobes secondary to severe parenchymal disease. Nurses and technicians should auscultate the thoraces of a variety of different patients, both

![Figure 2: A dyspnoeic cat open-mouth breathing should be handled very carefully to avoid deterioration](image)
normal and abnormal to improve their confidence with this technique.

Cardiovascular

The second area to evaluate is the cardiovascular system. After establishing a heart beat is present (if not present then immediate cardiopulmonary resuscitation is started), it is important to check the rate. Normal heart rate (HR) in the cat can vary from 100–200 beats per minute. Stress, pain and fear will cause a physiological tachycardia, which is not an indicator of cardiovascular disease. Presence of a tachycardia without any physiological causes may indicate cardiac disease. However, hypovolaemia (loss of circulating fluid volume, due to blood or fluid loss, or severe dehydration), pyrexia, hyperthyroidism or hypoxaemia can also result in tachycardia. Cats suffering from shock will often present with bradycardia. Bradycardia is important to note, as it may be indicative of impending cardiac arrest or severe hyperkalaemia.

It is good technique to palpate a central or peripheral pulse while auscultating the heart; an occasional heart beat without a corresponding pulse (‘pulse deficit’) is an indicator of an arrhythmia. A sinus arrhythmia, where HR increases with inspiration and slows on expiration is a normal clinical finding in dogs but is not normally seen in cats. Dull or quiet heart sounds may suggest pleural effusion or diaphragmatic hernia.

Pulse quality is a subjective assessment of how ‘full’ the pulse is and the femoral pulse should be assessed alongside peripheral pulses (dorsal pedal and carpal). Hyperdynamic (bounding) pulses may indicate anaemia while hypokinetic pulses tend to indicate a decreased circulating volume consistent with either hypovolaemia,
Clinical nursing

Congestive heart failure or potentially cardiac tamponade.

If possible, capillary refill time (CRT) should also be assessed as this can help to indicate tissue perfusion but avoid causing the cat distress with examination. Normal CRT is 1–2 seconds, prolonged CRT (>2 seconds) suggests peripheral vasoconstriction and poor perfusion while rapid (<1 second) is potentially concerning as it suggests vasodilation and a hyperdynamic state. The CRT is, however, a relatively insensitive method of assessing peripheral perfusion.

Neurological

The neurological system is reviewed once cardiovascular and respiratory stability has been assessed. If there is history of physical trauma, such as a road traffic accident, the head, neck and spine should be carefully examined. If there is any suspicion of damage, the patient should be immobilised as much as possible — this may require sedation.

Head trauma patients with raised intracranial pressure (ICP) must also be rapidly identified as continued rising of ICP can result in brain herniation. Increasing ICP may cause progressive alterations in breathing pattern and/or increases in mean arterial blood pressure accompanied by bradycardia. Important nursing considerations for patients with increased ICP include elevating the head and neck to a 30° angle above the heart (bedding can be used for this purpose) and ensuring no pressure is placed upon jugular veins, as this reduces venous drainage. Blood samples should, therefore, be obtained from peripheral veins.

The other consideration during triage of the neurological system is mentation. Head trauma and resulting brain damage can cause patients to present depressed or obtunded. These patients require immediate treatment.

Key point

Rapid identification of patients with head trauma and with raised intracranial pressure is essential. To reduce the risk of brain herniation, patients should have their head elevated to 30° above the heart and pressure to the jugular vein avoided.

Urinary

The fourth system to evaluate during triage is the urinary system. Road accidents or other trauma can result in rupture of the urinary tract and uroabdomen. The bladder can be gently palpated and further diagnostic tests may be needed such as contrast radiography to assess for bladder rupture. Serum potassium concentrations should also be measured as urinary tract rupture can lead to a severe hyperkalaemia which can cause cardiac dysrhythmias and, potentially, death.

Secondary assessment

Once the initial triage period is completed and any life-threatening injuries have been stabilised, a more detailed evaluation can be carried out. This includes performing additional diagnostic tests. The veterinary surgeon may choose to run some blood tests; for example, haematology to assess for blood loss, or biochemistry if urinary tract rupture is suspected.

Diagnostic imaging may be performed; radiography and ultrasonography will show any fractures, pleural space disease,
diaphragmatic rupture, abdominal effusions and various other problems. In some cases, a brief scan focused on one particular area is adequate to diagnose a problem requiring immediate attention — an example would be a dyspnoeic cat with ruptured diaphragm, with fluid and abdominal contents in the thorax.

Non-invasive blood pressure assessment is useful in any emergency patient — in cats a Doppler technique is more often used. Blood pressure (BP) can be measured via a cuff applied to the forelimbs, hindlimbs or even the tail. A low BP (hypotension) may indicate shock or hypovolaemia while increased BP (hypertension) may be due to central neurological disease, renal failure or physiological causes such as stress, pain or fear.

**Figure 4:** For accurate blood pressure measurement, the limb must be held level with the heart

It is important to bear in mind that the limb or tail must lie level with the heart in order for an accurate measurement to be collected (Figure 4). Cuff size is also an important consideration and the correct size will cover one-third of the limb/tail circumference. If the cuff is too big it will provide an erroneously low reading, too small and the reading will be high. To obtain accurate BP measurements the cat should be allowed to acclimatise to the surroundings; however, if the patient is collapsed on arrival it may be inappropriate to wait. In all cases, if there is a variability of >10% then the readings are regarded as unreliable.

**Initial treatment and nursing care**

The initial treatment and nursing required will be entirely dependent on the individual condition and will be assessed and advised upon by the veterinary surgeon. This may include intravenous fluid therapy (IVFT) tailored to the individual by considering the underlying problem, the hydration deficit and any concurrent medical problems that may affect the delivery of fluids (for example, heart disease). The veterinary nurse or technician will be involved in placement of the intravenous catheter, setting up of the prescribed fluids and monitoring the response. Parameters to monitor include HR, RR, pulse quality, respiratory effort and general demeanour. If fluid overload is occurring then the cat will become tachypnoeic and on auscultation there may be audible pulmonary crackles. If there is any concern over potential fluid overload, fluids should be discontinued immediately and the veterinary surgeon alerted.

Analgesia is an important consideration in any emergency patient. Ideally, a pain score is decided on admission and reassessed following analgesia. Opioid analgesics (for example, buprenorphine and methadone) are effective. In most cases starting with a low dose and performing pain assessments is an effective way of providing sufficient analgesia while ensuring that adverse effects are avoided. Non-steroidal anti-inflammatory drugs (NSAIDs) are...
Clinical nursing

frequently contraindicated in critically ill trauma patients due to the risk of renal and gastrointestinal damage associated with fluid volume deficits. If NSAIDs are required, these should be administered after any fluid deficit has been corrected.

General nursing considerations following triage are very important; this is the ideal time for the veterinary nurse or technician to have some individual input in the case. For example:

- ongoing pain management and pain scoring;
- provision of a comfortable bed in a quiet ward (use cat friendly clinic principles, see www.catfriendlyclinic.org);
- attention to nutrition and early feeding tube placement, if needed (Figure 5);

- turning of recumbent patients;
- bandage and cast care; and
- passive movement therapy, if appropriate.

Conclusions

The feline trauma patient can be a challenging case but the veterinary nurse or technician can play a crucial part in the triaging and follow-on care. Management of the acute emergency cat, as well as care of the hospitalised stable trauma patient, are areas veterinary nurses and technicians can make a big difference to their feline patients and can be very rewarding.

Further reading


Want to become a Cat Friendly Clinic?

Then, register for Cat Friendly Clinic materials and access the accreditation criteria and process.

The Cat Friendly Clinic programme is run by the ISFM in collaboration with several different partners across the world. It is designed to help create more cat friendly veterinary clinics, reducing stress for the cat as well as both the owner and veterinary staff treating the cat.

Find out more at: www.catfriendlyclinic.org

Key point

Don’t forget to consider the nutrition of trauma patients. If prolonged anorexia is predicted (eg, a cat with a jaw fracture), then a feeding tube should be placed and a nutritional plan created.

Figure 5: A cat with a jaw fracture is unlikely to eat adequately for some time
Risks from ingestion of human foods

Some human foods are a potential risk to pets, although severe poisoning in cats is rarely reported from these sources. Cats may eat human foodstuffs through inquisitiveness or by being fed inappropriate food by the owner or by a child. Foodstuffs that may cause poisoning in cats include alcohol, chocolate, Allium species (which includes onions and garlic), grapes and their dried fruits, and mouldy foods.

Some human foods are a potential risk to pets including cats. These foodstuffs are often left unattended or improperly stored. Potential circumstances of exposure to human foods in cats include inquisitive cats investigating shopping bags, fruit bowls or waste bins, cats fed leftovers and children feeding foodstuffs to their pets. Here the potential risks from the more common human foods are discussed describing the possible clinical signs and treatment options.

Alcohol
The alcohol in beers, wines and spirits is ethanol. Most beers contain 3–6% ethanol by volume, wines 10–14% and distilled beverages (whisky, gin, vodka, etc) between 20 and 60%. Ethanol is also used medicinally, particularly as an antidote for ethylene glycol poisoning and is found in surgical spirit and alcohol hand gel.

Clinical signs
The effects of ethanol are the same in animals as they are in humans. Ethanol is a central nervous system depressant and onset of signs is rapid (within 1–2 h). There is often vomiting (which may have an odour of alcohol), diarrhoea, excitability and agitation, and then depression, ataxia, disorientation, vocalisation and drowsiness.

Poisoning from human foods is much more common in dogs than cats, but the same substances can affect cats, and some cats do have a sweet tooth!
Keeping cats safe

In recovery from a significant exposure the cat is likely to be depressed and lethargic (hungover).

**Treatment**

Cases of ethanol poisoning in cats and even dogs are rarely reported in the literature. Treatment is supportive with maintenance of body temperature, monitoring and correcting blood glucose and general care of comatose patient, if required. Gut decontamination is usually not appropriate due to rapid absorption and onset of signs. Activated charcoal is not effective for ethanol ingestion.

**Allium species**

The *Allium* species are a large group of plants that includes leek, garlic, onion, spring onions, and chives. These are present in many foods including soups, baby foods, seasonings, stock cubes, sauces and marinades, chutneys, pickles, ready-made meals and many spicy products. Cooking, dehydration or spoilage of *Allium* species does not reduce toxicity.

**Mechanism of toxicity**

*Allium* species contain a variety of organosulphoxide compounds and trauma to the plants (such as

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**Chocolate toxicity**

Theobromine is toxic to most animals but there is limited information on the toxic dose of chocolate in cats. The oral lethal dose 50% (LD50 – the amount of an ingested substance that kills 50% of a test sample) for theobromine in cats is reported to be 200 mg/kg. This is approximately equivalent to 140 g/kg of milk chocolate and 35 g/kg of dark/plain chocolate, but the amount of theobromine in products varies due to natural differences in cocoa beans and the formulation of products (Figure 1). White chocolate contains a low concentration of theobromine and ingestion is unlikely to cause toxicity.

**Clinical signs**

In general, theobromine exposure is characterised by gastrointestinal effects and central nervous system stimulation. Clinical signs include vomiting, diarrhoea, polydipsia, lethargy, ataxia, depression or hyperactivity and tachycardia. In more severe cases, which are rare in cats, there may be tachypnoea, diarrhoea, tremors, seizures and arrhythmias.

**Treatment**

Treatment of chocolate toxicity is supportive and aimed at reducing absorption, rehydration and controlling CNS stimulation. Emesis is best avoided in animals with hyperactivity or excitability but activated charcoal can be given, if practical. Repeated dose activated charcoal (1–2 g/kg q4h until present in the stools) is useful as theobromine undergoes enterohepatic circulation. Diazepam can be given for sedation if necessary.

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*Figure 1: Milk, white and dark chocolate contain varying amounts of cocoa and thus theobromine*
chewing or crushing) converts these compounds to a variety of organic sulfur compounds including n-propyl disulfide, allyl propyldisulfide and allyl sulfide.

The main toxin, n-propyl disulfide, depletes the enzyme glucose-6-phosphate dehydrogenase (G6PD) within erythrocytes. Lower G6PD concentrations diminish the protective effect of the antioxidant, glutathione, as the glutathione remains in the oxidised state. This results in a mixed sulfide bond between haemoglobin and glutathione, which precipitates within the cell resulting in the formation of Heinz bodies. Erythrocytes that contain Heinz bodies are usually removed from the circulation by the reticuloendothelial system, thereby inducing anaemia. Feline haemoglobin is more susceptible to oxidative damage than the haemoglobin of other species.

Allium species poisoning in cats is relatively rare and it may be that cats do not find onions palatable, but poisonings have occurred following the ingestion of soups and meals with meat flavourings as the main constituent (see examples in Box 1). Effects can occur from a single large dose or smaller repeated dosing.

**Clinical signs**
The onset of clinical signs from Allium species poisoning is variable. Signs may occur suddenly within 24 h if a large quantity has been ingested but it is more common for signs to occur after several days. Signs of haemolysis may be delayed from 1–5 days. Heinz bodies can appear within 24 h and can increase in number over the next few days before declining. Death can occur but is unlikely with good supportive care.

**Box 1: Cases of onion poisoning**

Regenerative anaemia associated with Heinz body formation occurred in a cat that had been fed a brand of baby food, containing onion powder for 2 weeks. In another case two cats were accidentally fed onion soup and within 9 h Heinz bodies were observed in their erythrocytes. The Heinz body counts remained high for 24–48 h and then began to decrease. The cats appeared well but had slightly pale mucous membranes.

In an experimental study a cat was given onion soup equivalent to 28 g of onion/kg once a day for 3 days. Within 10 h of the first dose the erythrocytes and packed cell volume had decreased and the Heinz body counts increased up to 85%. On the fourth day most of the erythrocytes were irregular in shape and contained Heinz bodies. When twice the volume was given on the fourth day the plasma haemoglobin concentration rose rapidly and there was marked haemoglobinuria. The cat remained clinically normal throughout.

In another study cats were fed baby food containing onion powder (the concentration was proprietary and not disclosed, but approximately 1.8%) 53 g/kg daily for 5 weeks. None of the cats finished all of the food provided. The Heinz body percentage was greater in the baby food-fed cats than in controls and was significantly increased by day 7 and remained so until day 56 (26 days after cessation of administration). The mean maximum Heinz body count was 38% (range 33–53%).

**Key point**

Sick cats are sometimes tempted to eat with baby food, broths and stocks. Advise owners to check these products don’t contain onions or garlic.
Keeping cats safe

measures. Recovery usually occurs over 3–7 days, but can be longer in severe cases.

Gastrointestinal effects may also occur with inappetence, vomiting, abdominal discomfort and diarrhoea. The breath may smell strongly of onions or garlic.

The main concern is Heinz body anaemia. Clinical signs are those generally associated with anaemia; ie, depression, lethargy, weakness, pale mucous membranes, tachycardia and tachypnoea. Haematuria and haemoglobinuria are common (and may be the presenting signs). The urine may have an onion odour.

Haematological changes reflect oxidative damage with low packed cell volume (PCV) and haemoglobin, and erythrocytes with Heinz bodies. There may also be leucocytosis and neutrophilia. This is followed by a regenerative response.

Some animals may also develop a methaemoglobinæmia (where haemoglobin is converted to methaemoglobin), but this is usually mild. In severe cases, there may be jaundice due to haemosiderin (high iron stores) in the liver. Convulsions are a rare occurrence.

Treatment
There is very limited information on the acute toxic dose of Allium species in cats (most toxicity studies involve ingestion over several days or weeks). Toxic effects may occur in animals that ingest >0.5% of their body weight (ie, >5 g/kg) in Allium species.8

Any symptomatic animal should be assessed for anaemia. Animals without signs of anaemia can probably be sent home with advice to ensure adequate hydration and if possible to provide a high protein diet (may promote restoration of glutathione stores) and to return if there is any sign of anaemia (pale mucous membranes, lethargy, weakness, dark urine) over the next few days.

There is no specific treatment for Allium-induced anaemia and management is supportive.

In severe cases supplemental oxygen may also be required.8 A blood transfusion may be required in a critically ill animal.9,10

Grapes and their dried fruits
Although renal failure from grapes and their dried fruits (sultanas [Figure 2], raisins and currants) is well recognised in dogs there are also anecdotal doses of poisoning in cats, although few cases are reported.

The toxic mechanism remains unknown but the lack of dose response may reflect a component of grapes or dried fruit that is present in varying quantities or an extrinsic compound that is not always present in or on the grapes.11

Figure 2: Grapes are toxic in fresh or dried form

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Clinical signs
Clinical signs from grapes and dried fruit ingestion include vomiting, diarrhoea, bloody stools, anorexia, tender abdomen, ataxia, weakness and lethargy. The creatinine concentration is expected to rise from about 24 h and the urea from 24–72 h. As renal failure progresses there may be bradycardia, hypo/hyperthermia, anaemia, respiratory depression and convulsions. Cats with pre-existing renal impairment may be more at risk of toxicity after ingestion of grapes and dried fruit. If the product involved is chocolate-coated raisins there is also a potential risk of chocolate toxicity.

Treatment
After ingestion of grapes and dried fruit treatment is aimed at decontamination and maintaining urine output. Treatment is recommended following ingestion of any quantity of grapes, raisins, sultanas or currants in dogs, and this should be considered in cats. Repeat doses of activated charcoal every 4 h may be of benefit.

Aggressive IV fluid therapy (eg, twice the normal maintenance rate) for at least 48 h for rehydration and to support renal perfusion is recommended. The renal function and electrolytes should be monitored for at least 72 h post-ingestion. It is also important to monitor for signs of fluid overload

Mouldy food
Mycotoxins are fungal metabolites that cause toxicity in humans and animals. Tremorgenic mycotoxins are present in some mouldy foods (including dairy products, bread, rice and fallen fruits and nuts), silage and compost (Figure 3).

Mechanism of toxicity
There are a number of tremorgenic mycotoxins but only a few are of clinical significance. Penitrem A and roquefortine are the common mycotoxins associated with poisoning in small animals.

The mechanism of action is unclear and may vary with the mycotoxin. Penitrem A may interfere with the release of neurotransmitters (glutamate, aspartic acid and...
Keeping cats safe

GABA),13,14 It has also been shown to induce tremors in mice by acting as an antagonist to production of the neurotransmitter glycine.15 The tremorgenic mycotoxins may also act synergistically.

Tremorgenic mycotoxicosis is rarely reported in cats, and is much more common in dogs. It should be suspected in any animal with sudden onset tremors with a history of raiding a bin. Also fungal growth is most prevalent if the weather is warm and wet.

Clinical signs
Tremorgenic mycotoxicosis is rapid in onset, usually within 30 minutes but sometimes up to 3 h.16,17 Most animals recover within 24–48 h with aggressive treatment,18 particularly if treatment is started soon after ingestion.

There is frequently vomiting, irritability, ataxia, whole-body muscle tremors, rigidity with hyperextension of extremities, hyperactivity, hyperaesthesia, tachycardia, panting and tachypnoea. In serious cases severe tremors and opisthotonus, convulsions and coma with paddling. Aspiration is a potential hazard. The increased muscle activity can lead to pyrexia, exhaustion, rhabdomyolysis, dehydration and hypoglycaemia.

Treatment
Induction of emesis is probably best avoided because of the risk of rapid onset of clinical signs. Repeated doses of activated charcoal are recommended due to enterohepatic recirculation of the mycotoxins.

If the cat is vomiting and has severe tremors or convulsions an antiemetic may be required to reduce the risk of aspiration pneumonia.

Treatment is supportive ensuring adequate hydration, monitoring respiration and temperature, cooling measures if required and ventilatory support in animals with severe respiratory depression.

Key point
Keeping human food away from cats and other pets is sensible advice for owners.

Diazepam is often ineffective in cases of tremorgenic mycotoxicosis, so propofol, methocarbamol or a barbiturate can be used. If tremors/convulsions are not controlled general anaesthesia may be required. Another option is the use of a lipid infusion as both penitrem A and roquefortine are lipophilic.

Conclusions
Potentially harmful foods are present in all households, although severe cases of toxicity in cats are rarely reported. It is important, however, to inform owners about the potential risks and advise them to store these foods safety and dispose of waste promptly to prevent accidental ingestion.

References
3 Lincoln SD, Howell ME, Combs JJ, et al.


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WEDNESDAY 5 APRIL 2017

NEW for 2017
One day nursing programme

Brand new for 2017, ISFM is running a programme for nurses/techs. Split into manageable sessions, the talks will be full of practical hints and tips to take back to practice.

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<td>09.00–10.00</td>
<td>Registration</td>
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<tr>
<td>10.00–10.45</td>
<td>Contentment with confinement – coping with carriers and crates</td>
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<td>Sarah Ellis, International Cat Care</td>
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<td>10.45–11.30</td>
<td>Cats under stress – clinical significance and importance</td>
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<td>11.30–12.00</td>
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<tr>
<td>12.00–12.45</td>
<td>Implementing Cat Friendly Clinic principles in practice</td>
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<td>Martha Cannon, Oxford Cat Clinic</td>
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<td>12.45–13.30</td>
<td>Pain scoring in cats - new tools and practical implications</td>
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<td>13.30–14.30</td>
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<td>Analgesics and analgesic therapy – what you need to know</td>
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<td>15.15–16.00</td>
<td>Causes, management and monitoring of cats with seizures</td>
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<td>Choices and management of long-term urinary and IV catheters</td>
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<td>The role of the nurse in managing the feline diabetic</td>
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