State of the art
Delayed anaesthetic recovery

Behaviour
Giving advice to kitten owners

Keeping cats safe
Exposure to weedkillers

Case study
Urethral obstruction
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✔ Cat going into a cattery?
✔ Owner moving home?
✔ Is there a new arrival in the home?
✔ Expecting fireworks?

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Welcome to a packed and varied November edition of Feline Focus which, I think, has many practical tips that you can take to work tomorrow. We start with a state-of-the-art article on delayed anaesthetic recovery. The statistics on anaesthetic complications clearly show recovery is the period when most problems occur, so this article reminds us not to leave postoperative patients unmonitored.

We then have the second part of Trudi Atkinson’s series on preventing and managing problem behaviours, which provides tips on client communication. Can you help educate your clients effectively to prevent problems in the future? We move on to cover the toxicity of weedkillers. Poisoning with herbicides is uncommon but owners may be concerned and it is important to know the signs of intoxication. We finish with Kathryn Welsh’s case study on a common presentation: urethral obstruction.

Remember to register for our monthly webinars, and access the recordings at www.icatcare.org/nurses.

Best wishes,

Sam Taylor, Veterinary Editor

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Delayed anaesthetic recovery in cats: causes, recognition and treatment

The majority of feline anaesthetic complications occur in the recovery period, due to decreased observation and vital parameter monitoring, termination of oxygen supplementation, hypothermia and extubation. Causes of delayed recovery may include: delayed anaesthetic drug metabolism, adverse perioperative events (including hypothermia, hypovolaemia, hypoglycaemia and hypoxaemia) and underlying disease. Recovering patients should be closely monitored by a veterinary nurse or technician until fully conscious to allow identification and treatment of complications delaying recovery from anaesthesia.

General anaesthesia is defined as a state that prevents awareness and response to painful stimulation as well as restraint, immobility and relaxation of skeletal muscle. Recovery from general anaesthesia is a vital part of the anaesthetic process. It is defined as the period that starts when administration of anaesthetic agent is ceased and ends when the patient is fully conscious.1

A large multicentre study assessing anaesthetic-related mortality, which included 79,178 cats undergoing sedation or general anaesthesia, showed that the overall risk of death in cats was 0.24% (189 deaths). Of this figure, 60% of deaths occurred during the recovery period, proving it to be the phase of anaesthesia when cats are most at risk.2

The increased risk of mortality during recovery can be associated with:

- termination of oxygen administration: hypoxaemia may develop in patients that are hypoventilating due to the residual effect of anaesthetic drugs.
- termination of vital sign monitoring: when heart and respiratory rates are no longer monitored, potential apnoea, bradycardia

Key point

When in the recovery phase of anaesthesia, patients should be closely monitored by a member of veterinary staff.
or cardiac arrest may go unrecognised.

- **development of hypothermia:** the temperature of patients in recovery may progressively decrease and this may prolong the recovery.
- **extubation of the trachea:** loss of airway control may predispose to airway obstruction. Furthermore, if regurgitation occurs when the laryngeal reflexes are not completely restored, the patient may aspirate stomach contents.

In practice, patients may sometimes be left unaccompanied during the recovery period while still under the depressant effects of anaesthetic drugs. If any complications were to arise during these unmonitored periods, recognition may be delayed. It is important that patients are continuously monitored during recovery, at least until they regain consciousness and control of airway reflexes. A trained member of veterinary staff should be present to restore patient safety should a (potential) complication arise.

It is difficult to define the appropriate duration of recovery as this may be affected by duration of anaesthesia, doses and duration of drugs, patient metabolism and concurrent diseases. Prolonged recovery is a complication that must be recognised quickly, diagnosed accurately, and responded to appropriately. In the case of a delayed recovery, one must determine whether it is a normal recovery for this patient or a pathological delay, which should be addressed.

**Causes of delayed recovery**

Delayed recovery in cats may occur for a variety of reasons including:

- **drug-related causes:** some drugs have a prolonged duration of action or drugs given for extended periods of time may accumulate.
- **adverse perioperative events:** hypothermia, hypoglycaemia, hypovolaemia, hypoventilation and hypoxaemia may all impact recovery times.
- **metabolic causes:** patients may have underlying hepatic, renal or endocrine dysfunction that may affect the speed in which drugs are metabolised and/or eliminated.

**Drug-related causes**

Drug effect can be influenced by many factors and the same doses can produce different effects on different patients. For example, paediatric and geriatric patients may be more sensitive to the effects of sedative drugs and require lower doses compared with middle-aged adults. It is, therefore, advised to tailor drug doses to individual patient requirements and not refer to pre-constructed weight-dependent charts.

**Sedative drugs**

The most commonly used drugs for the sedation and premedication of cats include:

<table>
<thead>
<tr>
<th>Drug</th>
<th>Intravenous</th>
<th>Intramuscular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acepromazine</td>
<td>10–20 μg/kg</td>
<td>20–40 μg/kg</td>
</tr>
<tr>
<td>Medetomidine</td>
<td>5–10 μg/kg</td>
<td>10–20 μg/kg</td>
</tr>
<tr>
<td>Dexmedetomidine</td>
<td>2–10 μg/kg</td>
<td>5–10 μg/kg</td>
</tr>
<tr>
<td>Midazolam</td>
<td>0.2–0.3 mg/kg</td>
<td>0.2–0.3 mg/kg</td>
</tr>
<tr>
<td>Diazepam</td>
<td>0.2–0.5 mg/kg</td>
<td></td>
</tr>
</tbody>
</table>

**Key point**

Prolonged recovery needs to be recognised quickly and appropriate intervention taken promptly.
cats are phenothiazine’s, alpha-2 agonists, benzodiazepines and opioids. See Table 1 for the authors’ recommended doses of sedative drugs.

Acepromazine, a phenothiazine, is the only drug in this class that is licensed* for pre-anaesthetic use in small animals. It has a long duration of action (up to 6 h) and cannot be antagonised. Therefore, if the procedure being performed is relatively short, sedative effects may continue into the recovery period. The main cardiovascular effect of acepromazine is vasodilation; this has potential to increase heat loss and predispose to the development of hypothermia, another factor that affects the duration of recovery.\(^3\)

In the UK, medetomidine and dexmedetomidine are both alpha-2 agonists licensed* for use in cats. They provide dose-dependent profound and reliable sedation as well as good analgesia.\(^4\) The effects of alpha-2 agonists can also be antagonised with atipamezole, an alpha-2 antagonist. Atipamezole can be administered intramuscularly to shorten recovery periods; however, the analgesic effects provided by the alpha-2 agonist are also antagonised and, therefore, it is recommended that alternative analgesia is administered where needed.

Benzodiazepines include diazepam and midazolam and these drugs are not licensed* for use in animals. Their effect when administered alone in cats is unreliable and varies from none to very mild sedation or excitement.\(^5\) However, when administered in combination, they enhance the effect of sedative drugs, potentially prolonging recovery periods, especially in geriatric or paediatric patients. Midazolam may be administered intravenously and intramuscularly; diazepam has variable uptake and it is therefore not recommended for intramuscular administration.

### Opioids

Opioids are analgesic drugs and are commonly administered in combination with a sedative to enhance its sedative effects and provide analgesia. The effect of opioids varies between species; dogs and humans tend to be more sensitive to their sedative effects, whereas cats and horses are more prone to develop excitatory effects.\(^6\) In the UK, the licensed opioids in cats are methadone, pethidine, buprenorphine and butorphanol. Methadone, pethidine and buprenorphine are \(\mu\) receptor agonists and can be antagonised using naloxone, a \(\mu\) receptor antagonist. In the authors’ experience it is rare that opioids need to be antagonised to allow a faster recovery; but, if this is the case, alternative analgesia should be provided. See Table 2 for suggested doses of opioids in cats.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Intravenous</th>
<th>Intramuscular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methadone</td>
<td>0.1–0.2 mg/kg</td>
<td>0.2–0.4 mg/kg</td>
</tr>
<tr>
<td>Pethidine</td>
<td>3–5 mg/kg</td>
<td></td>
</tr>
<tr>
<td>Buprenorphine</td>
<td>20 (\mu)g/kg</td>
<td>20 (\mu)g/kg (also sublingual)</td>
</tr>
<tr>
<td>Butorphanol</td>
<td>0.2–0.4 mg/kg</td>
<td>0.2–0.4 mg/kg</td>
</tr>
</tbody>
</table>

\(^*NB:\) Licensing regulations vary from country to country.
State of the art

consequently don’t cause delayed recovery. Propofol and alfaxalone have been used for total intravenous anaesthesia (TIVA) protocols in cats. Cats are unable to glucuronidate efficiently due to deficiency of the enzyme glucuronyl transferase, which is responsible for metabolism of phenolic compounds like propofol. For this reason, prolonged infusion of propofol may be associated with delayed recoveries. Conversely, alfaxalone does not accumulate in cats, and may be a more suitable choice for TIVA. Ketamine normally undergoes hepatic glucuronidation and an active metabolite is produced (norketamine). In cats, ketamine is excreted mostly unchanged in the urine and renal dysfunction may considerably prolong its duration of action.

Volatile anaesthetic agents
Recovery from inhalation anaesthetic agents is primarily reliant on pulmonary elimination. The rate at which the elimination occurs is dependent on ventilation and the concentration gradient between the patient’s blood and airways. To encourage a quick recovery, it is important to ensure adequate patient ventilation, increase the fresh gas flow and empty the reservoir bag to eliminate residual anaesthetic gas from the breathing system.

Adverse perioperative events

Hypoventilation
When the patient enters the recovery phase of anaesthesia, residual effects from anaesthetic and sedative drugs may depress ventilation. Consequently, the patient may develop hypercapnia, which is defined as arterial carbon dioxide level above 45 mmHg. Severe hypercapnia (>65 mmHg) has the potential to cause mental impairment and can lead to respiratory arrest. It may also lead to the development of hypoxaemia in a patient breathing room air. Other factors that may predispose to hypoventilation are:

- hypothermia;
- neurological disorders such as increased intracranial pressure (which depresses the function of the respiratory centres in the medulla oblongata);
- cervical spinal cord lesions (that interfere with the origin of the phrenic nerve which innervates the diaphragm); and
- trauma to the thoracic cavity resulting in pain on inspiration.

Hypoxaemia
Hypoxaemia is defined as a low concentration of oxygen within the blood. During inhalational anaesthesia, patients receive high concentrations of inspired oxygen (80–100%). Once the patient is in recovery the inspired oxygen concentration drops to 21% (room air). Patients may be hypoventilating and may not be able to compensate for the drop in inspired oxygen by

Figure 1: Tongue cyanosis in a cat during recovery from general anaesthesia
increasing ventilation, which could easily lead to hypoxaemia.\textsuperscript{13}

Hypoxaemia can be recognised by assessing mucous membrane colour and by using a pulse oximeter. Gross hypoxaemia leads to cyanosis (Figure 1); however, this is an inaccurate assessment method as it can be influenced by anaemia, tissue perfusion and poorly lit environments.\textsuperscript{14}

Pulse oximetry measures the percentage of haemoglobin saturated with oxygen in arterial blood (SpO\textsubscript{2}) and it is efficacious in detecting hypoxaemia in the recovery period. SpO\textsubscript{2} should be measured when the patient is disconnected from the anaesthetic machine. Values below 90% indicate hypoxaemia and oxygen should be supplemented. If pulse oximetry is not used, hypoxaemia may go unnoticed and lead to central nervous system depression, bradycardia, hypotension and, ultimately, cardiac arrest.\textsuperscript{15}

Tip
Postoperative shivering caused by hypothermia may increase oxygen consumption by up to 400%, which may predispose to hypoxaemia.\textsuperscript{16}

Hypothermia
Hypothermia is one of the most well recognised consequences of general anaesthesia and temperature should always be monitored during recovery, especially if prolonged (Figure 2). The small size of feline patients predisposes them to develop hypothermia, due a high surface area to body weight ratio. Hypothermia in cats can be classified into three categories: slight (38.5–36.5°C), moderate (36.5–34.0°C) or severe
Hypothermia develops as a result of:
- muscle inactivity during general anaesthesia and sedation;
- depressant effect of anaesthetic drugs on the thermoregulatory centre in the brain;
- clipping of hair and increased airflow over the patient’s skin;
- heat loss due to conduction; for example, direct contact with the operation table and skin prepping solutions (Figure 3);
- cold environmental temperature;
- evaporation through respiration and through open body cavities during surgery.

Hypotension
Hypotension can be associated with hypovolaemia, reduced myocardial contractility and vasodilation. It may result in hypoperfusion of vital organs such as the brain, which can lead to organ dysfunction and cause altered mentation. Blood pressure should be monitored during recovery in debilitated patients, or those with prolonged recovery, and hypotension treated.

Liver disease
Patients with liver disease (or patients less than 5 months of age) may demonstrate a delayed recovery due to decreased metabolism of drugs. Considerations when anaesthetising patients with decreased liver function are to:
- avoid drugs that require extensive hepatic metabolism. Preferentially choose drugs with extrahepatic metabolism;
- use short-acting drugs;
- use lower doses compared with those used in healthy patients; and
- use drugs that can be antagonised.

Hypoglycaemia
Young, diabetic and anorexic patients which have been fasted are at risk of developing hypoglycaemia. The brain is solely dependent on glucose as its energy source and, should this become deficient, the patient may display neurological deficits including confusion, ataxia and seizures, which can eventually progress to a coma. During anaesthesia these clinical signs are masked. Therefore, it is imperative to regularly check glucose levels in patients that may be at risk of hypoglycaemia.

Hyperthyroidism
Hyperthyroidism is uncommon; however, hyperthyroidism is more likely to be diagnosed in feline patients. A stable hyperthyroid cat should not suffer from a delayed recovery as drugs are generally metabolised faster. The increased metabolism caused by the hyperthyroidism can potentially lead to tissue hypoxia if a higher oxygen demand is not met. Therefore, it may be beneficial to supplement oxygen during recovery to these patients.

Kidney disease
Kidney function is important for the secretion of drugs. Decreased renal function may lead to an accumulation of drugs with renal-dependent clearance, for example, ketamine. Patients with kidney disease may also be more prone to dehydration, due to an inability to concentrate urine.
**Actions to take when recovery is delayed**

When feline patients do not recover from anaesthesia within an appropriate time frame the following steps are suggested:

- **patent intravenous access:** patients should have IV access during anaesthesia. In recovery, ensure the catheter is patent to be able to administer emergency drugs.

- **check airway patency as well as respiratory function:** assess respiratory rate and chest movement. If upper respiratory noise is present, open the mouth and pull the tongue out to improve air flow. Elevating the head may also help to open the airway. If airway obstruction is suspected the trachea should be intubated and ventilatory support provided. The use of capnometry during recovery provides information on the patient's respiratory rate and end-tidal carbon dioxide, which helps in the assessment of respiratory function.

- **check patient's oxygenation by using pulse oximetry:** if hypoxaemia is present (SpO₂ <90%), oxygen should be administered. Oxygen may be administered by face mask, nasal prongs (although not well tolerated by feline patients) or in an oxygen cage (for example, a paediatric incubator, see Figure 4). It is important that stress is avoided as this may worsen the hypoxaemia.

- **consider using antagonists:** if there is the possibility that a drug may still be acting during recovery, it may be possible to use an antagonist drug to reverse its effects. Be aware, however, that the drug's analgesic properties will be antagonised as well.

- **evaluate the cardiovascular system:** assess heart rate, pulse quality, mucous membranes colour (remember this may be unreliable in anaemic or vasoconstricted patients) and blood pressure. Administration of intravenous fluids should be considered if hypovolaemia is suspected.

- **monitor body temperature:** if hypothermia develops, active warming should be implemented. Heat can be provided by electrically heated mats, warm air mats or by paediatric incubators (Figure 5). The patient should remain under observation when active heating is started and
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Key point
Vital signs, including temperature, pulse and respiration, should be monitored until a patient has regained full consciousness after anaesthesia.

Conclusions
Until a patient has regained full consciousness after anaesthesia, vital signs should be monitored, including temperature, pulse and respiration. Detection of abnormalities should be prompt and support should be provided where necessary.

References

temperature should be frequently measured until normothermia returns. When using active heating devices care must be taken to avoid patient burns; if mental status is diminished, the patient may not be able to move away from excessive heating.

• assess pain: a painful animal may be less inclined to move, which will predispose it to develop hypothermia. Cranial abdominal pain and thoracic pain may be associated with hypoventilation and consequently a reduction of speed in which the patient exhales volatile agents. A painful animal may become aggressive and this may limit ability to monitor vital parameters during recovery. Analgesia should always be provided during surgical procedures and continued in the postoperative period.

• assessing a basic blood profile: packed cell volume, total proteins, electrolytes and glucose levels may aid in ruling out any haemorrhage, anaemia, electrolyte imbalances or hypoglycaemia which could be affecting the recovery period.

Figure 5: Patient recovering in a paediatric incubator
15 Powell JF, Menon DK and Jones JG. The effects of hypoxaemia and recommendations for postoperative oxygen therapy. Anaesthesia 1996; 51: 769-772.
International Cat Care’s much-loved charity calendar is back for another year, with a new theme – *Cat Naps*. This A4-sized calendar features images of cats from all over the world – some are old and some are young, some are owned and some are strays, but they’re all enjoying what cats love most – sleeping! All proceeds go to support International Cat Care’s work in improving the health and welfare of cats worldwide.

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Prevention of behaviour problems 2: how to pass on preventive behavioural advice

Offering early advice to owners can be a successful way to prevent behaviour problems, but there are a number of ways in which this information can be presented. Handouts can be beneficial but should not be relied upon as the only means of client education. Talking to the owner and offering hands-on demonstrations is preferable and this may be done during a consultation, or by running kitten clinics or kitten ‘kindies’. However, there are number of factors to be considered before deciding which is best for your practice and your clients’ pets. Evening or weekend events for clients without their cats may also be employed as a way of passing on advice to all cat owners irrespective of the pet’s age.

As the veterinary practice is one of the first places an owner will visit with a newly acquired cat or kitten, and somewhere that most will visit at least once a year, veterinary practice staff, especially nurses, are in an ideal position to help educate and pass on preventive advice. There are a variety of different ways that this may be achieved.

Via handouts
Handouts are always a good idea as clients can keep them and refer to them as needed. However, they are best used as a backup to verbal advice, rather than as a ‘stand-alone’ means of client education, as there can be no guarantee that a client will read them, or fully understand the information they contain.

Pictures can make handouts or information sheets more appealing. The inclusion of practice logos and contact information not only makes them a form of advertising for the practice, but also ensures the clients knows how to get in touch with the practice.

Tip
Make sure any client handouts avoid veterinary terminology and include only essential information.

This article is the second in a series of three appearing in consecutive issues on the role of the veterinary nurse in the prevention and management of feline behaviour problems. For the first part see: Prevention of behaviour problems 1: what advice can be given to kitten owners. Feline Focus 2016; 2(10); 273–280.

Trudi Atkinson
RVN DipAS(CABC) CCAB

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practice should the need arise.

It is important that the text is interesting, clear and concise, containing very little more than the most essential information and, ideally, free from veterinary or behavioural terminology. If terminology is unavoidable, a definition should be provided. Providing the necessary information in bullet points can be a good idea as it can make the handout easier to read and the information it contains the most salient part of the text. Clients may be less inclined to read handouts that are complex or contain too much solid text. If excessive unnecessary peripheral information is included there can be a risk that the essential points may be overlooked. (See Box 1 for example of text content for handout.)

**At the first visit/consultation**

The first consultation can provide an opportunity to pass on behavioural advice, but extra time, and possibly extra staff, might be needed to impart all the required information at the time of each separate consultation. In a busy practice this may not always be possible or practicable.

Most importantly, it should never be underestimated how much influence a kitten’s first experience of the veterinary practice can have on its future behaviour, especially in the veterinary context. Cat Friendly Clinic guidelines (see www.catfriendlyclinic.org) to minimise fear and stress and to ensure that the experience is as positive as possible for the kitten, are therefore especially important at this time (Figure 1).

---

**Box 1: Example text for an owner handout on house-training**

**HOUSE-TRAINING YOUR CAT OR KITTEN**

**Introducing the litter tray**
- Allow your new cat or kitten to approach and explore a new litter tray before he needs to use it.
- If you notice him scratching around or squatting somewhere other than the litter tray, pick him up gently and place him in the nearest litter tray — but do not do this until he has had a chance to explore and become familiar with the tray.
- Never scold him, or be rough with him.

**Positioning the litter tray**
- Make sure that the litter trays are easy to find.
- Place litter trays well away from the cat’s food, water and sleeping areas.
- Avoid areas where he may feel at threat. Places to avoid are:
  - Close to doorways or French windows where the cat may be seen by other cats outside.
  - Anywhere where there is a high chance that he might be disturbed.
  - In any location where other household cats can ambush him as he tries to get to or move away from the litter tray.

**Choice of cat litter**
- If you know what type of litter your new cat or kitten has been using previously, continue using it. If you don’t know, then try a fine granular, unscented litter, as this is what most cats will prefer.
- Ensure that the litter is deep enough for the cat to dig into it and bury his waste.

**Number of litter trays**
- Many cats prefer to use one area to pee and another to poo and not all cats like to share a litter tray. So if you have just one cat you need to provide two trays. If you have more than one cat the recommended number of trays to provide is one per cat, plus one extra.
- It is important that the litter trays are positioned well apart from each other, preferably in separate rooms. If the trays are too close to each other the cats will regard them as just one toileting location and may be more likely to eliminate elsewhere.

**Cleaning the litter tray**
- Some cats are more fastidious than others, but the best policy is usually to clean out any faeces and/or wet patches as soon as you notice them and wash and rinse the tray completely once a week.
Kitten clinics

Nurse-led ‘kitten clinics’ can be an excellent way to provide preventive client education and support. As well as offering verbal advice and related handouts, these clinics can also provide an opportunity for ‘hands-on’ demonstrations and to allow owners to practise things such as gentle, stress-free handling, grooming (Figure 2) and medicating. Food treats and/or play can also be offered for the kittens to help make this a positive event for them. Sufficient time should be allowed for each consultation so that advice on general health care as well as behavioural advice can be offered and owners’ questions and concerns can be addressed.

Figure 1: A kitten’s experience during its first consultation can have a highly significant influence on its future behaviour, especially in the veterinary context. Cat Friendly Clinic guidelines are especially important at this time (photograph courtesy of Richard Murgatroyd)

Kitten classes

A kitten class (kitten kindergarten or ‘kitten kindy’)<sup>1</sup>,<sup>2</sup> is an event similar to a practice puppy party or class, but for kittens. There are potential advantages and disadvantages in holding kitten classes and it is important to be well aware of the social, behavioural and developmental differences between puppies and kittens and relevant practicalities if considering running these in your practice.

The recommended age for kittens attending kitten classes is between 8–13 weeks; after the kitten has had at least the first set of its primary vaccination course. This is much younger than is recommended for puppies attending puppy classes, because the primary socialisation period in cats is far shorter than it is in dogs, ending at approximately 7–9 weeks,<sup>3</sup> as opposed to 12–18 weeks in dogs. Also as a kitten

Figure 2: Nurse-led kitten clinics can be an excellent way to provide preventive advice as well as providing an opportunity to demonstrate stress-free handling, grooming and medicating (photograph courtesy of Richard Murgatroyd)

Key point

Kitten clinics run by veterinary nurses are a valuable way to impart information that could prevent future behavioural problems.
matures the likelihood of social play with other kittens diminishes and there can be an increased, albeit slight, risk of play leading to actual aggression (Figure 3).4

This fairly small window of opportunity means that most kittens would only be able to attend one or two sessions at most, and for some their primary socialisation period will already be over by the time they are able to attend their first session.

In the UK, most pedigree kittens would be completely excluded as it is a recommendation as part of the code of conduct of the Governing Council of the Cat Fancy that kittens are not passed on to their new homes until they are at least 13 weeks of age.5

However, as long as all the kittens attending have been sufficiently well socialised beforehand, kitten classes can provide an opportunity for ongoing social referencing, most essentially gentle and correct handling by a variety of people and a general broadening of experience, which can be advantageous in increasing the kitten’s general confidence and tolerance of handling by different people.

Kitten classes can also provide a good opportunity for kittens and owners to be introduced to a variety of different toys, and owners can be educated as to how to play with their kittens. Owners can also be given ‘hands-on’ advice and demonstrations on grooming, medicating and training. However, much of this can also be achieved in a kitten clinic consultation.

Two other possible advantages of kitten classes are that the kittens may benefit from learning social skills and how to interact with other kittens. It is debatable as to whether this would have a great deal of influence on the behaviour of the adult cat towards unknown cats as the ability to be social naturally lessens with age.4,6 The other possible advantage is that practice-based kitten classes may teach the kitten good associations with the veterinary practice. However, there

Figure 3: As kittens mature there can be an increased risk that social play (a) may escalate into actual aggression (b). Note the differences in body language (eg, ear position) between these two photographs.

Key point

Kitten classes are much more challenging to run than puppy classes. The earlier socialisation period means kittens attend at a younger age, and as they mature the likelihood of social play diminishes. Much of what is discussed at such classes can be covered in nurse-run kitten clinics.
can be no guarantee that a kitten will enjoy the experience, and for some, especially the innately timid or less well socialised kittens, the experience may be too intense and possibly frightening, which could then increase rather than decrease the risk of fear-based behaviours developing in association with the veterinary practice.

Practicalities also need to be considered. Unlike puppies, which can be kept on leads and generally have a greater desire to stay with or close to their owners, kittens are more likely to explore. This could cause supervision and management difficulties, or even potential injury to the kittens if the area is not sufficiently well ‘kitten proofed’ against escape, access to potential hazards or to small places inaccessible to human hands.

It is recommended that no more than three to six kittens, preferably the lesser number, attend each session and that there are two instructors to each class. Therefore, another consideration is to weigh up the necessary time and staff required versus the number of kittens that may benefit.

**Feline information events**
The major disadvantage of all the aforementioned means of client education is that they are aimed only at kittens and kitten owners. Feline behavioural problems can develop at any time in a cat’s life so, clearly, it is not only kitten owners that can benefit from preventive behavioural advice.

Evening or weekend events for all cat owners to attend without their pets can be one way to pass on general health care and behavioural advice, irrespective of the pet’s age or how long it has been in the

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**Education events for breeders**

As mentioned in part 1 (Prevention of behaviour problems 1: what advice can be given to kitten owners. *Feline Focus* 2016; 2[10]; 273–280), there are many ways that breeders can play an essential role in the prevention of feline behaviour problems (Figure 4). The selection of breeding animals, and the husbandry, general care and housing of the pregnant queen can have a direct influence on the kittens’ behaviour. Additionally, because the feline socialisation period ends long before most pedigree kittens are sent to their new homes, the onus for supplying adequate positive socialisation lies entirely with the breeder. So offering specific advice for breeders, as outlined in part 1, by way of handouts and/or education events is equally as important as offering advice to owners. Breeders can also be instructed as to what advice to pass on to new owners.

![Figure 4](photograph courtesy of Alexandra Taylor)
owner’s care. As well as being a means of client education, these events can also be a good way of promoting the practice and its commitment to feline care. They can be made more attractive to the local cat-owning public by having guest speakers, competitions and free refreshments, and by providing cat owners with an opportunity to meet the staff and to be given a tour of the practice facilities. Making the events open to all, not just practice clients, and advertising in the local press, via social media as well as in the practice itself, can also help to bring in as many people as possible and make it worthwhile for the practice.

Further advice and information for clients
Whatever way advice and information is passed on to clients, the nurse should always be prepared to answer more in-depth questions with correct and relevant answers, but also be able to recognise when a client’s question or concern is out of their area of knowledge and then be able to recommend suitable reading or online material, such as that provided by International Cat Care (icatcare.org), or to recommend another professional who may be more able to help or answer a client’s queries.

References
Risks from exposure to weedkillers

Many different products are available for the control of weeds, but they generally contain only a few different herbicidal compounds. This is particularly true for those products designed for use in the garden (rather than agricultural products). Cats may be exposed to spills or drips of liquid products or by walking on treated grass, brushing against wet weeds and grooming, or, rarely, from ‘spray drift’. In most cases gastrointestinal irritation is the only likely clinical sign but some herbicides, such as glyphosate, can cause significant respiratory signs in cats. Fatty acids can cause oral ulceration. It is important to establish which product the cat was exposed to, to determine the potential risks and appropriate treatment.

A large number of weedkiller (herbicidal) products are used to control weeds in the garden (Figure 1). However, products available for domestic use (as opposed to those available for professional use) only contain a few different herbicidal compounds. Also, products for use in the garden are generally less concentrated and less hazardous than professional agricultural products.

Sources and routes of exposure

There are numerous herbicides available so it is important to determine which particular product a cat may have been exposed to. The owner may be able to tell you the name and the ingredients of the product involved. Information can also be found on one of the pesticide databases which are freely available on the internet (see Box 1).

Cats are generally exposed to weedkillers during or soon after use. They do not tend to chew and destroy containers as dogs will. Cats may be exposed to weedkillers in
the garden by walking on treated grass (Figure 2) or brushing against wet plants and then grooming (Figure 3). They may also walk in or lick up spills or drips from sprayed weeds, or may occasionally chew treated plants or, rarely, be exposed to ‘spray drift’.

**Glyphosate**

Glyphosate is a widely used and readily available herbicide. It is present in many products as it is a broad spectrum post-emergence herbicide (that is, it is effective against different types of weeds and applied after the weed has started to grow), is of relatively low toxicity, lacks residual soil activity, does not bioaccumulate and is biodegradable. Although glyphosate is an organophosphate compound, it has no anticholinesterase activity (unlike the organophosphate insecticides which can cause serious toxic effects).

Glyphosate is primarily available in liquid formulations but these may vary in strength. Many products contain a surfactant, polyoxyethylene amine (POEA), which improves the wettability of plants for maximum coverage and helps the glyphosate to penetrate through the plant surface. Glyphosate is considered of low toxicity and it is this surfactant present in many liquid preparations that is believed to be responsible for some of the effects.

**Clinical signs**

Vomiting, anorexia and lethargy are common signs in cats after glyphosate exposure. There may also be diarrhoea, tremors, drowsiness and dilated pupils. Severe respiratory signs are a feature of glyphosate exposure in cats, and include cyanosis, tachypnoea or dyspnoea, pulmonary oedema and bronchopneumonia. In a review of Veterinary Poisons
Information Service (VPIS) cases, the fatality rate in cats was 22% compared with 5% in dogs. All four cats with bronchopneumonia had a fatal outcome.1

Eye and skin irritation are also possible after exposure to glyphosate-containing products.

Treatment
If there is dermal exposure the cat should be thoroughly washed.

If a cat has ingested a small quantity, particularly of a dilute solution from grooming or licking a spill or wet plant, washing out the mouth and oral fluids are probably all that is required. If there is definite ingestion, particularly of a more concentrated solution, activated charcoal (1–3 g/kg orally) can be given. An emetic is not recommended as the surfactant in glyphosate-containing products may pose an increased aspiration risk. An antiemetic should be given to reduce the risk of aspiration. Treatment thereafter is supportive.

Chlorophenoxy derivatives
The chlorophenoxy derivative weedkillers include 2,4-D (2,4-dichlorophenoxyacetic acid), MCPA, mecoprop and dichlorprop. They are frequently found in combinations in products and are also used in lawn feed and weed products. They are available in granular form or as liquid; these chemicals are not very soluble in water and solvents may be

Box 1: Finding product information on pesticides

Europe
You can find the ingredients of pesticide products sold in the UK by searching the Health and Safety Executive’s (HSE) Pesticides Register. https://secure.pesticides.gov.uk/pestreg/ProdSearch.asp
You can search by product name, active ingredient, product registration number, use, amateur or professional products and more.

For other European countries find the relevant database by going to:
http://www.eppo.int/PPPRODUCTS/information/information_ppp.htm

USA
For information on pesticide products in the US, see the Environmental Protection Agency (EPA) website:
https://iaspub.epa.gov/apex/pesticides/f?p=PPLS:1

Canada
See the Pest Management Regulatory Agency website:
http://pr-rp hc-sc.gc.ca/ls-re/index-eng.php

Australia
See the Australian Pesticide and Veterinary Medicines Authority (APVMA) website:

New Zealand
See the Agricultural Compounds and Veterinary Medicines (ACVM) website:
present in liquid formulations. The mode of action of poisoning of chlorophenoxy herbicides is not understood. The gastric effects are probably due to their acidity. They may affect plasma membranes, interfere with cellular molecular pathways involving acetyl coenzyme A and also uncouple oxidative phosphorylation resulting in the energy that would be stored as adenosine triphosphate (ATP) being dissipated as heat.3

Few cases of chlorophenoxy poisoning are reported in cats and most published information available is from experimental studies in dogs (which are thought to be particularly sensitive to these compounds).

Clinical signs
These compounds are irritant and can cause hypersalivation, vomiting, abdominal discomfort and lethargy. In severe cases there may be bloody stools, anorexia, progressive weakness and myotonia, then coma. Opisthotonus may also occur. Oral ulceration has been reported in cats exposed to chlorophenoxy herbicide-containing products although it may be due to other ingredients (VPIS data).

Key point
Decontamination, by washing, is the first step of treatment for any herbicide exposure.

Treatment
Treatment of poisoning from chlorophenoxy derivatives is supportive. There is no specific antidote. In many cases exposure is minimal and dermal decontamination and washing the mouth out with water, with rehydration and an antiemetic, is all that is required. These compounds are poorly soluble in water so it will be necessary to use a detergent for dermal decontamination.

For liquid products containing only chlorophenoxy derivatives, emesis is best avoided because of the risk of aspiration of the volatile solvents present in some products.

Ferrous sulfate
Ferrous sulfate is used as a moss killer. It may be available as the chemical itself but is more commonly found in ‘lawn feed, weed and moss killer’ products which contain a fertiliser (the feed), an herbicide (the weedkiller, often a chlorophenoxy derivative) as well as ferrous sulfate (the moss killer). These products are generally used to revive the lawn between March and October and are available as granular products for sprinkling on the lawn or products to be diluted in water and poured over the lawn. Granular products are generally used before rain is expected or are watered in after use. Ferrous sulfate is also available in iron tablets for the management of iron-deficiency anaemia.

Clinical signs
Overdose of iron can cause toxicity because the body has no system of eliminating excess iron. Overdose of iron causes gastrointestinal irritation, and in severe cases liver failure, renal failure (secondary to shock), hepatic failure, metabolic acidosis, coagulopathy, cardiovascular collapse and convulsions. These severe signs are unlikely to occur unless the cat has eaten a large quantity of a moss killer. Dermal contact with these products (eg, walking on a treated lawn) may cause local irritation and grooming.
the product or licking treated grass may cause gastrointestinal irritation with vomiting, hypersalivation, diarrhoea and polydipsia.

**Treatment**

If a cat has walked on a treated lawn the feet should be washed with a detergent. Treatment thereafter will be supportive, with an antiemetic if required and rehydration if necessary. This is generally all that is required in most cases.

If the cat has ingested a large quantity of a ferrous sulphate-containing moss killer then gut decontamination is appropriate with an emetic, followed by rehydration and monitoring of liver enzymes, clotting parameters, renal function and fluids status.

Rehydration is essential in the management of iron toxicity because of fluid loss due to the corrosive effects on the gastrointestinal tract. An antiemetic may be required and gastroprotectants (H₂ blockers, sucralfate, omeprazole) may be helpful. A serum iron concentration would be helpful to determine the severity of poisoning but it will rarely be available in a clinically useful timeframe.

In severe iron poisoning, parenteral desferrioxamine (deferoxamine) is used as an antidote. It binds free iron removing it from cellular binding sites. The desferrioxamine-iron complex can sometimes impart a pink-brown colour (described as vin rosé) to the urine. The decision to use desferrioxamine should be based on the patient’s clinical condition and on laboratory analyses. It is usually only used in severe poisoning (eg, altered mentation, gastrointestinal bleeding, acidosis, hypotension, shock, hepatotoxicity, convulsions) and is of limited benefit more than 12 h after ingestion.⁶ The mainstay of treatment is supportive management.

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**Fatty acids**

Octanoic acid (caprylic acid), decanoic acid (capric acid) and nonanoic acid (pelargonic acid) are examples of naturally occurring fatty acids found in some weedkillers, particularly those labelled organic. Nonanoic acid is found in the oil of pelargonium (a common bedding or house plant) and has also been used as a cat repellent. The other two fatty acids have names referring to goats (capr-) because they have a goaty odour.

**Clinical signs**

Few cases of exposure have been reported in cats, probably because they do not like the smell. In animal studies, these compounds have been found to be irritant⁹⁻¹¹ and, in the small number of cases reported to the VPIS, cats have developed signs of local irritation in the mouth with anorexia, hypersalivation, oral ulceration and pyrexia (VPIS data). There is also the risk of severe skin irritation from prolonged contact.

**Treatment**

Cats exposed to a herbicide-containing fatty acids should be decontaminated promptly. Fatty acids are not very soluble in water so a detergent should be used for dermal decontamination. If the cat has groomed or licked the product,
oral lavage should be attempted. Treatment thereafter will be supportive with analgesia and in severe cases syringe feeding, if necessary.

Conclusions
Severe signs in cats from exposure to herbicide products used in the garden are not common but glyphosate is a particular hazard and associated with respiratory complications. For most other herbicides the clinical signs are limited to gastrointestinal irritation, probably because cats are usually only exposed to a small quantity.

Owners should be advised to read the packaging on pesticide products and use them according to the manufacturer’s instructions. It may be difficult to prevent access to these products in free-roaming cats and if the owner is concerned that the cat may lick treated plants or spills of herbicide it may be best to avoid their use and control weeds by manual removal.

References
Case study

Oscar: a case of urethral obstruction

This case describes the management of a cat presenting with urethral obstruction. This presentation is a true emergency and requires immediate veterinary attention. In this case, the owner had changed the cat’s litter and the cat had a history of inappropriate urination indicating stress. The cat was treated with opioid analgesia, intravenous fluids and anaesthetised to allow urethral catheterisation. The bladder was catheterised and urinalysis revealed some struvite crystals, which may have been involved with the obstruction but can be found in normal cats. An indwelling catheter was placed. The cat was re-presented 3 weeks later with further signs of cystitis but was not obstructed. Advice should be given to owners on prevention of stress in cases like this to avoid recurrence.

A number of factors have been suggested as contributing to the development of urethral obstruction in cats including feeding a dry diet, being male, neutering, obesity, an inactive lifestyle, being kept indoors, stress and multicat homes. Probably all of these factors contribute to the development of urethral obstruction.

Signalment
Oscar was an 18-month-old, male neutered, domestic shorthair weighing 5 kg (body condition score 3/5).

History
Oscar presented as an emergency overnight following an initial phone call reporting abdominal swelling. Further questioning revealed that a change in cat litter had led to him urinating in abnormal places, but today no urine had been noticed. The cat was fed a dry diet and lived with other cats. He was bright and alert on presentation, mucous membranes were pink, capillary refill time less than 2 seconds, skin tent normal, heart rate 190 beats per minute, respiratory rate 24 breaths per minute and temperature 38.0°C. Abdominal palpation revealed a large, hard and painful bladder. The attending veterinary surgeon suspected urethral obstruction (‘blocked bladder’). Investigations and treatment were discussed with the owner and consent obtained for sedation/general anaesthesia to allow urethral catheterisation, blood tests, and intravenous fluid therapy (IVFT). Initially, methadone was injected intramuscularly but due to

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Case study

Tip
If a cat is distressed, it may be better to sedate for blood tests and other procedures than cause further stress by attempting to restrain the cat.

the cat’s demeanour (anxious and distressed) and pain he was sedated prior to obtaining bloods, which although not ideal also allowed placement of an intravenous catheter for fluid therapy.

Bloods were taken for minimum database (packed cell volume/total solids, lactate [can provide an indication of perfusion], blood glucose and blood urea nitrogen), blood gases and electrolytes. All were within normal limits. Anesthesia was induced using a small volume of propofol given IV to effect and the cat intubated and maintained on isoflurane. The urethra was catheterised gently using a 4 French ‘Slippery Sam’ (polytetrafluoroethylene) cat catheter (Figure 1), which has an opening at the end facilitating gentle flushing of the urethra with fluid, to atraumatically remove any obstruction (retropulsion). Minimal obstruction was encountered.

A sample of urine was obtained via the catheter revealing a specific gravity of 1.020 (the cat had been receiving fluid therapy likely lowering the specific gravity), protein (2+), and on sediment examination struvite crystals. The bladder was emptied and flushed with warmed sterile saline. The catheter was then removed and replaced with a KatKath (Vygon Vet) and this was sutured into place. A soft catheter of adequate length is advised for indwelling urethral catheterisation. A collection bag was attached, to allow for accurate monitoring of urine production (Figure 2). By securing the tubing of the collection bag to his tail, Oscar was still able to move around without this interfering or pulling on the catheter, causing pain.

Figure 1: A ‘Slippery Sam’ cat catheter can be useful for relieving urethral obstruction due to the end opening, but sometimes a stiffer type of catheter is required.

Figure 2: A ‘homemade’ closed urine collection system using a sterilised drip bag. Commercial systems are available. Spot the deliberate mistake: this cat should ideally have a soft buster collar as the stiff plastic ones may cause additional distress. The cage would also benefit from a bed/box to hide in (eg, an igloo bed)

Oscar was given meloxicam as an additional analgesic once fully recovered from the anaesthetic and normotensive — his blood urea nitrogen was normal suggesting no renal damage due to the obstruction. He was monitored closely overnight following recovery from anaesthesia for adequate urine
production to ensure we were matching his outgoings with IVFT and to ensure pain was controlled. The following morning he was bright and stable with normal vital parameters.

Nursing treatment
Post-obstructive diuresis
Due to pressure necrosis, medullary washout, osmotic diuresis and resistance to anti-diuretic hormone once urethral obstruction is relieved, cats may produce large volumes of urine. This can result in dehydration and hypovolaemia. High fluid rates may be required and cats should be closely monitored for under- or over-hydration. The diuresis can cause hypokalaemia, even in cats that presented with hyperkalaemia. If a cat is producing little or no urine (<2 ml/kg) then this must be reported to the veterinary surgeon as the cat may have acute kidney injury. Check the catheter is patent before diagnosing anuria.

Ongoing assessment
Monitoring should include:

- assessment of urine production: initially every hour to ensure the catheter is patent and the patient is producing urine. The urinary bag can be drained every 2–4 h but, unless blocked, the urinary catheter should not be disconnected from the tubing to avoid infection. It is, of course, vital to keep the urinary bag below the level of the patient to prevent urine running back into the bladder (Figure 2). Gentle palpation of the urinary bladder (take care to avoid trauma to the bladder) to assess if urine is being produced and flowing down the catheter can be reassuring.

- assessment of analgesia: analgesia should be provided at all times as the condition is very painful. Buprenorphine is an effective analgesic in this situation.

Key point
Urethral obstruction and cystitis are very painful conditions and affected cats should receive adequate pain relief. Buprenorphine is an effective analgesic in this situation.
Case study

Non-steroidal anti-inflammatory drugs should be avoided if kidney damage is suspected (azotaemia) or the cat is hypotensive (due to anaesthesia or fluid deficits).

• assessment of electrolytes: urea, creatinine and urinalysis should be measured post-unblocking.

Outcome
Oscar was discharged to his own daytime veterinary clinic the following morning, where he stayed for a further 3 days with the indwelling urinary catheter. Unfortunately, he re-presented to us 3 weeks after the initial presentation with stranguria. He was not obstructed at this time and idiopathic cystitis was suspected and treated with analgesia. It was strongly advised to discuss urinary diets, ongoing medications and importantly behavioural modifications with their own vet as no alterations had been made following the initial episode.

Discussion
Upon presentation and initial suspicion of a urethral obstruction, the focus should be on the cardiovascular system. Although the

Cat Friendly Clinic priorities

In cases of indwelling urinary catheterisation we use soft Buster collars (Figure 3) rather than rigid ones, as cats may be wearing them for several days.

To assist with reducing stress we cover the kennel door with a towel and provide an igloo bed for hiding in. It is important to ensure the cat has space to move around. We often use a double kennel with bedding and food at one end and the litter tray at the other. This is of extra importance once the catheter has been removed as cats generally won’t toilet near their food.

As urinary conditions in cats are often stress related, Cat Friendly Clinic principles are very important, such as keeping cats away from the sight, sound and smell of dogs, and avoiding loud and sudden noises.

Tip
Maximising the ‘cat friendliness’ of your clinic will be particularly useful for cats with urinary tract disease as they are often already very distressed.

Figure 3: A cat with a urethral catheter and a soft Buster collar. Note the cat also has a soft igloo bed to ‘hide’ in but can still be observed and monitored.
obstruction must, of course, be relieved, rushing to anaesthetise the cat (especially with agents that affect the cardiovascular system) may cause a deterioration in the cat’s condition. Cats with urethral obstruction may be hyperkalaemic and determination of the effect of the potential hyperkalaemia on the heart is an urgent step.

Some practices may not have the ability to measure serum electrolytes but, ideally, an electrocardiogram (ECG) should be attached to the cat as soon as possible after placement of an intravenous catheter. (For more information on the management of hyperkalaemia, see Critical nursing of the blocked cat. Feline Focus 2015; 1[11]: 375–382.)

The cat in this case was presented prior to the development of hyperkalaemia but still required urgent treatment to catheterise the urethra and correct any fluid deficits.

This case illustrates a common presentation of urinary problems in cats and also highlights some important points:

- **analgesia** is vital. Idiopathic cystitis and urethral obstruction are very painful and urethral spasm associated with the pain can potentiate obstruction. Appropriate pain relief must be provided.

- **stress avoidance** in the clinic. Stress exacerbates this condition. Efforts should be made to follow Cat Friendly Clinic guidelines when such cats are hospitalised.

- **struvite crystals** can be found in normal cat urine, particularly if the cat is fed dry food or the sample is not examined immediately, but in the case of a blocked cat the finding may be significant. Feeding a wet diet will help reduce the supersaturation of the urine with crystals.

- **follow-up** is important to avoid recurrence. This cat presented with signs of idiopathic cystitis again a few weeks later and no advice had been given to prevent further episodes. (For more information, see Feline idiopathic cystitis: the nurse’s role in aftercare. Feline Focus 2015; 1[9]; 335–338.)

**Conclusions**

Urethral obstruction is a true emergency and the veterinary nurse or technician plays a vital role in the care of such cases and the follow-up to prevent a recurrence.

**Stress and urinary problems**

A two-part article on stress-related feline urinary problems written by Professor Tony Buffington, an expert on feline idiopathic cystitis, has been published in Feline Focus: Multimodal environmental modification (MEMO) for prevention and treatment of disease in cats: parts 1 and 2 (Feline Focus 2015; 1[8]: 275–280 and 2015; 1[9]: 311–317).