Feline permethrin toxicity

Permethrin is a pyrethroid insecticide. Pyrethroids are synthetic analogues of pyrethrins, which are naturally occurring substances extracted from Chrysanthemum flowers. Permethrin is a neurotoxin that binds to and blocks open sodium channels on the surface of neurons. This interferes with nerve function by causing the neurons to discharge repetitively.

Cats are very sensitive to permethrin and are more likely to develop signs of toxicity than dogs. Permethrin is metabolised by the liver. It is suspected that cats may be more prone to toxicity because they have different liver metabolic pathways to other species; in particular they have a deficiency of the enzyme hepatic glucuronosyltransferase.

Routes of exposure
Exposure to even small quantities of permethrin can cause severe and fatal poisoning in cats. Cats are usually exposed to permethrin when pet owners accidentally apply permethrin-containing flea and tick spot-on products, which are made for dogs, to cats. These products usually come in a small pipette and the liquid is applied to the skin on the back of the neck. The liquid is then absorbed through the skin and into the body. Permethrin containing spot-on products are used in many countries around the world.

Key point
Cats are usually exposed when well intentioned owners apply spot-on flea products designed for dogs. They may also be exposed by grooming or brushing against recently treated dogs.
Keeping cats safe

Dogs are less sensitive to the toxic effects of permethrin and these products are safe to use on dogs but not on cats. Often owners do not realise that the products can only be used on dogs, accidentally mix up different dog and cat products or they do not understand that they can result in fatal toxicity if used on cats. Another route of exposure occurs if a cat grooms a dog in the same household that has had the product applied. It is not known for certain how long cats should be separated from dogs after dogs have had permethrin-containing products applied, but 72 hours is often recommended.

Clinical signs
Signs of toxicity are usually seen within a few hours but can take 1–2 days to develop. Common signs of toxicity include: muscle tremors, twitching, seizures, ptyalism, ataxia, hyperaesthesia, pyrexia and mydriasis. Clinical signs can vary from mild facial twitches to persistent severe generalised tremors.

Diagnosis
Diagnosis is based on a known exposure to permethrin and clinical signs consistent with toxicity.

Differential diagnoses for tremors/seizures may include the following:
- Intra-cranial causes such as;
  - infectious disease (eg, toxoplasmosis, cryptococcosis, feline infectious peritonitis);
  - inflammatory disease;
  - neoplasia;
  - trauma;
  - idiopathic epilepsy; or
  - vascular (eg, thrombosis or haemorrhage).

Extra-cranial causes such as;
- toxins (eg, lead, ethylene glycol, organophosphates);
- metabolic disease (eg, hepatic insufficiency, hypoglycaemia, hypocalcaemia, hypo- or hypernatraemia, erythrocytosis).

Key point
Treatment focuses on decontamination by washing the product off to reduce absorption, controlling tremors, and giving supportive care. There is no antidote for permethrin toxicity.

Treatment
Treatment of cats with permethrin poisoning can be very intensive and expensive. There is no antidote for permethrin toxicity.

There are three main aspects to treatment:
- decontamination;
- control of tremors;
- supportive care.

Decontamination
Most cats are exposed after having permethrin products applied to the skin. Decontamination involves thorough washing of the cat with lukewarm water and a mild hand dishwashing detergent. Fur may also be clipped off at the application site. The aim is to remove as much of the oily product as possible to stop further absorption through the skin.

Treatment of muscle tremors
Treatment of muscle tremors may involve the use of various different medications depending on the severity of clinical signs and what products are available. Methocarbamol is a centrally acting muscle relaxant that is often
used intravenously or can also be given orally in less severe cases. Benzodiazepines such as midazolam may be used intravenously as a bolus or as an intravenous infusion. Barbiturates such as phenobarbitone may also be used. Severely affected cats may require heavy sedation or general anaesthesia to control clinical signs; e.g., a propofol intravenous infusion (Figure 1).

**Lipid emulsion therapy**

Another treatment that may be used, in combination with medications aimed at reducing tremor activity, is an intravenous infusion of a lipid emulsion. This treatment may help to reduce the time taken for clinical signs of toxicity to resolve. Lipid emulsion therapy can be used for treatment of toxicity from lipid-soluble drugs or toxins and is thought to work by providing a ‘lipid sink’ so that the toxin is sequestered within the intravascular space and cannot reach its sites of action.

**Supportive care**

Supportive care involves intravenous fluid therapy and close monitoring.

Affected cats are often hyperaesthetic and their tremors may worsen with handling and noise. They may benefit from housing in a dark and quiet room. Heavily sedated or anaesthetised cats may require supplemental oxygen, endotracheal intubation, temperature monitoring and active warming if required, turning and ocular lubrication to prevent the development of corneal ulcers. Other parameters to monitor may include SpO₂, ETCO₂, blood pressure and urine output.

Cats will usually require anywhere from a few days to a week of treatment in hospital before slowly recovering. Some cats with severe signs do not survive, require prolonged hospitalisation or develop complications such as corneal ulcers or aspiration pneumonia.

**Prognosis**

With early treatment and intensive care most cats will survive permethrin toxicity, however, the costs of treatment may be prohibitive for some cat owners. Publications from the UK, USA and Australia report mortality rates of up to 37% (died or euthanased).

**Prevention and the role of veterinary nurses and technicians**

Veterinary nurses have a major role in both the prevention and
Case study: Jasper’s accidental exposure to permethrin

Signalment
Jasper is a 5-year-old male neutered domestic shorthair.

History
Jasper’s owner split a permethrin-containing flea spot-on product, manufactured for use on large dogs, between Jasper, their small dog and their pet rabbit. Six hours later Jasper was found unable to stand, drooling and with severe generalised tremors. Jasper’s owners contacted their local veterinary hospital with no idea of the cause of his clinical signs. The veterinary nurse on duty was able to advise them that immediate veterinary attention was required and brief questioning determined that this was a possible case of permethrin toxicity. The nurse advised the owners to bring the flea product packaging into the hospital for confirmation. The nurse alerted the veterinarian on duty and commenced preparing equipment ready for Jasper’s arrival.

Presentation
Jasper had severe generalised tremors, marked ptyalism, hyperaesthesia and there were greasy patches of fur where the flea product had been applied.

Treatment
Careful handling was required to be able to place an intravenous catheter and immediate treatment with midazolam, methocarbamol and intravenous fluids was administered. Once his tremors had reduced, blood was collected for an emergency analysis. Packed cell volume, total protein, electrolytes and urea were within reference intervals. The affected regions of fur were clipped and he was washed with a mild dishwashing detergent.

Initially, Jasper’s tremors reduced in severity, however, they later worsened and, as a result, he became pyrexic. He was then treated with a propofol infusion. Heavy sedation was required to control the tremors and so Jasper had an endotracheal tube placed (Figure 2). He was also treated with supplemental oxygen, temperature monitoring and regulation, ocular lubricants and was turned every 2 h.

Jasper required intensive nursing care and monitoring. Every 4 h the propofol dose was reduced to assess for recurrence of tremor activity.

Thirty hours later the propofol infusion was able to be discontinued and Jasper was extubated. At this stage he had continued intermittent fine facial and limb twitches. Twenty-four hours later he was greatly improved with only mild intermittent limb twitches and feeding was recommenced.

Outcome
The following day Jasper was well enough to be discharged from hospital.
treatment of feline permethrin toxicity. Nurses assist in educating owners about routine preventive health care such as parasite control. Educating pet owners about which flea and tick products are safe to use on cats, explaining appropriate administration and ensuring that pet owners read and understand product labelling is essential. International Cat Care has campaigned on this topic and a poster (Figure 3) is available to download at: http://icatcare.org/sites/default/files/pdf/permethrin_poster_vet.pdf

Veterinary nurses are often the first point of contact for pet owners when they call a veterinary hospital for emergency advice about possible toxicity. Understanding the importance of rapid assessment and treatment at a veterinary hospital is essential to be able to advise pet owners. Veterinary nurses are also key in the initial emergency assessment and treatment of these patients and in their ongoing hospital care and monitoring.

**Report incidences of toxicity**

It is important to report feline toxicities to the appropriate body in your country. This ensures that up-to-date information is available about the incidence of toxicities in companion animals and what toxins are involved.

**Further reading**