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Myiasis in domestic rabbits

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ABSTRACT: As rabbits continue to be a popular species of domestic pet, myiasis, also referred to as fly strike or blow fly strike, is a problem seen all too often in veterinary practice. An estimated 94.5% of veterinary practices in the southwest of England and Wales treated at least one rabbit for flystrike between May and September 2005, (Bisdorff & Wall, 2006). Nurses should be aware of the causes and clinical signs of myiasis, the treatment options available and the required nursing skill and knowledge necessary to provide gold-standard care for these patients. The importance of thorough clinical examination when these cases present must be highlighted, alongside the necessity of diagnosing underlying causative factors and implementing good anaesthetic techniques for these debilitated and at-risk animals.

Causes and signs

Myiasis is caused by flies laying eggs on the skin of rabbits, and bottle flies (green, black and blue) are recognised as the primary instigators (Girling, 2003). The eggs develop into first-, second- and third/final- stage larvae (referred to as maggots) which feed off damaged tissue. Tissue erosion and necrosis are common in cases of myiasis, often around the perineum and tail fold (Scarff, 2000). Rabbits that have soiled hair and skin attract flies during the hot weather, often predisposing them to fly strike (Cousquer, 2006a) (**Figure 1**).

Clinical signs

Initial clinical signs of myiasis include soiling around the perineum, anorexia, lethargy, diarrhoea and depression (Cousquer, 2006b). At this stage, the eggs may be unhatched and careful examination is required for accurate diagnosis. Often, prior to eggs hatching,

the rabbit may show signs of predisposing problems such as dental disease or gastrointestinal abnormalities. Meredith and Crossley (2002) record clinical signs of myiasis as depression, collapse and death. These are associated with more advanced cases in which eggs have hatched and tissue damage and systemic infection are substantial.

Causes

Faecal accumulation around the perineum is a common cause in hotter months and can be due to factors such as poor nutrition, dental disease, obesity, or reduced mobility causing reduced grooming behaviour (Cousquer, 2006b) (**Figure 2**).

Urine scalding also predisposes rabbits to myiasis, as skin around the perineum and lateral hind limbs becomes sore and painful to groom. The presence of bacteria in these regions attracts bottle flies and ova are laid on to the skin surface. Thus, the presence of crystalluria



Figure 1. A rabbit with fly-strike wounds



Figure 2. Faecal contamination of the perineum

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and bladder infections are potential causes of urine scalding and the possibility of poor environment leading to behavioural urine retention should be considered (Fisher, 2010). Kidney disease and *Encephalitozoon cuniculi* have also been discussed as causes of urine scalding (Cousquer, 2006b).

Handling and restraint

Handling of rabbits with myiasis can cause concern, as a rabbit's rump should usually be supported whenever lifted and this is the most common site of myiasis. As Girling (2003) notes, struggling rabbits can kick out and, due to the power in their hind limbs, cause dislocations or fractures of the spine. Equally, it is important to avoid or minimise stress when handling rabbits as severe stress may induce cardiac arrest, and so minimal restraint is preferred to reduce the likelihood of this occurrence (Girling, 2003).

A healthy, non-aggressive rabbit with no external wounds can be lifted by placing one hand under the thorax, with the handler using their thumb and first two fingers to grasp and control the front limbs; the other hand can then be placed under the rump of the rabbit to support its spine (Girling, 2003) (**Figure 3**). Fractious rabbits may require scruffing and restraining under the handler's arm (Malley, 2000).

In cases of myiasis, placing a hand under the hind limbs can cause interference with painful wounds, causing discomfort and compromising hygiene. Alternatively, the rabbit can be lifted with one hand around the thorax and one supporting



Figure 3. Correct lifting of a rabbit

the caudal abdomen. Handling should be minimal to reduce stress and is often only required for movement to and from the examination table.

Clinical examination

A thorough examination should involve physical checks for gastrointestinal disturbances, obesity, dental disease and mobility issues. Discussion of the rabbit's living environment, behaviour and diet is also essential.

Harcourt-Brown (1995) discusses the common incidence of dental disease in domestic rabbits, leading to anorexia, weight loss and the inability to groom effectively, this has also been recognised by Deeb (2000). These conditions have the potential to cause diarrhoea and/or soiling around the perineum, attracting flies and increasing the likelihood of myiasis. Obesity can predispose gastrointestinal disturbances, reduced grooming behaviour and reduced mobility. Agar (2001) discusses the link between obesity in rabbits and their inability to access caecotrophs, stating 'the rabbit is too fat to be able to reach its anus and cannot therefore ingest the caecotrophs'. The soft and sticky faecal matter thus accumulates around the anus, increasing the risk of fly strike.

Reduced mobility due to obesity, trauma or poor environmental conditions may mean the rabbit is less inclined to remain clean. Paralysis or severe arthritis can lead to incontinence and skin becoming soiled with urine and caecotrophs, (Van Praag, 2010).

The possibility of hyperglycaemia should also be assessed. A recent study by Harcourt-Brown, F, & Harcourt-Brown, S, (2012) revealed high occurrences of hyperglycaemia in anorexic rabbits, especially those in stressful situations: they state 'stress levels in rabbits can be difficult to assess'. Rabbits rarely show active signs of stress and many passive signs such as immobility and unresponsiveness go unnoticed in busy hospital environments. Rabbits with myiasis are often anorexic and are admitted into threatening hospital environments with predators in close proximity causing them to suffer from stress at clinically significant levels.

Blood samples for assessing glucose levels can be obtained by sampling the jugular vein using appropriate restraint. This involves restraining on non-slip surfaces

and positioning the rabbit at the table edge. The neck should be extended with the jaw raised and forelimbs held below the table top (Malley, 2000). Alternatively, the marginal ear vein can be used to obtain a small sample for measurement using a glucometer (Harcourt-Brown, F, & Harcourt-Brown, S, 2012).

Anaesthetic considerations

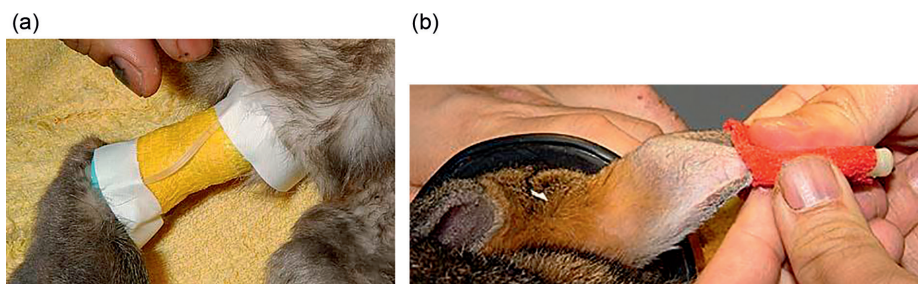
Rabbits with myiasis will have reduced food and water intake and present as depressed, in discomfort and even shocked, often requiring anaesthesia for wound treatment. Cousquer (2006a) discusses the choice of anaesthetic agents and shows a preference for those allowing smooth induction and rapid recovery.

Placement of endotracheal tubes should be standard protocol, allowing for effective oxygen administration via suitable breathing systems. Non-rebreathing systems, such as the Ayres T-piece, with low dead space and low resistance are ideal (Wenger, 2012).

Hypoxia is a common complication in rabbit anaesthesia (Flecknell, 2000) but it is easily corrected with oxygen administration. Endotracheal tubing allows efficient administration of maintenance levels of inhalant agents should the length of injectable anaesthesia be insufficient. Flecknell (2000) notes that inhalant agents are preferable to the re-administration of injectable agents, even at reduced dosages, if prolonged anaesthesia is required. A reduction in laryngospasm has been seen in rabbits anaesthetised with a midazolam-ketamine combination in comparison to medetomidine-ketamine, but both combinations offer total reversal via suitable antagonists (Wenger, 2012).

Combination anaesthesia (use of more than one anaesthetic drug) in this species has become the gold standard of anaesthesia. Clark and Hall (1999) state that combination anaesthesia has become the preferred method in general practice as the use of a single anaesthetic agent at a high dose is not advised for any patient and this approach in rabbits has led to the high mortality reported in the species.

Maintaining body temperature whilst under anaesthesia is achieved by using external heat sources. Bair huggers and circulating warm-water blankets



▣ **Figures 4 a & b.** Intravenous fluid therapy should be considered whenever possible

are most effective (McHugh, Young & Johnson, 2011) and Self (2007) recognises the positive effects of bubble wrap in maintaining body temperature.

Fluid therapy should be considered for patients with myiasis that are undergoing anaesthesia. Flecknell (2000) observes that the peripheral vasodilatation and reduction in cardiac output seen with most anaesthetic drugs can be accelerated if rabbits are dehydrated, and circulatory collapse then becomes a significant threat.

Perioperative fluid therapy should form part of routine protocol when treating these patients and, if venous access proves challenging, other routes can be considered. Laber-Laird, Swindle and Flecknell (cited in Self, 2007) advise a total volume of 50ml of intraperitoneal fluids for 3kg rabbits. This can be administered peri-operatively and should be warmed to body temperature so that normothermia is maintained. Intravenous routes should be considered whenever possible (Self 2007). In cases where rabbits show clinical signs of shock, fluid rates up to 90ml/kg/hour can be used initially and maintenance rates based on the degree of dehydration. Continuous infusions of 5–10ml/kg/hour should continue until rabbits are drinking normally again (Cousquer, 2006b) (**Figure 4a and 4b**).

Wound management

Meredith and Crossley (2002) list the following requirements for treating myiasis:

- flushing of the wound site
- systemic antibiotics
- ivermectin
- ensuring the underlying condition is treated or addressed

Cousquer (2006a) states that removal of second- and third-stage maggots should be undertaken first, whilst Van

Praag (2010) advocates using blunt tweezers to minimise further tissue damage. First-stage larvae and eggs also require removal from the wound, but may require repeated attempts for complete success, and the duration of anaesthesia that is required should be taken into account. Whilst it is essential to clip the fur in the area in order to visualise all the larvae, it should be minimal to reduce risks associated with hypothermia. The area should be dried gently with a hairdryer (cool, low power setting only) and a flea comb should be used to ensure all eggs are groomed away (Cousquer, 2006a).

Chlorhexidine, a biguanide compound, is commonly used in small animal practice. It is an excellent skin and wound disinfectant and, as discussed by Monsey and Devaney (2011), has good activity against Gram-positive bacteria but is less effective against Gram-negative bacteria and mycobacteria. Povidone-iodine has a broad spectrum of activity, although both preparations are recognised as being effective in treating fly strike by Van Praag (2010).

Concentration levels of chlorhexidine and povidone-iodine need to be considered as, if not diluted at the correct rate, they can cause damage to skin cells. Tennant (2002) advises dilution of chlorhexidine for topical treatment to a 1% concentration, applied every 8–12 hours, and advises a povidone-iodine 0.5% solution to be used as a wound cleanser.

Hydrogels applied to affected damaged tissue and covered with a moisture-vapour permeable dressing are advocated in order to protect exposed dermal tissue (Cousquer, 2002a).

Drug treatment

Antibiotics

Systemic antibiotics can be achieved with the use of enrofloxacin and trimethoprim combinations. These are both effective

and safe for rabbits in cases of myiasis, (Cousquer, 2002b).

Pain relief

Rabbits are well known for showing limited signs of pain, but pain leads to inappetence, which increases the risk of chronic gut stasis. Pain should be addressed as a precaution and a combination of the opioid buprenorphine, alongside a non-steroidal anti-inflammatory drug such as carprofen will provide excellent analgesia (Morris, 2000, Cousquer, 2006b). The infiltration of long-acting local anaesthetics such as bupivacaine into the wound site can also provide a good level of analgesia (Flecknell, 2000) for 6–8 hours (BSAVA, 2011).

Gastrointestinal motility

Metoclopramide can also be administered to rabbits following anaesthesia. It acts as a gastrointestinal motility stimulant and increases peristaltic activity. This can help to ensure that the gut continues to work effectively and gut stasis is not a post-anaesthetic concern if appetite is reduced (Wenger, 2012).

Paracitcides

Ivermectin can be used in the treatment of myiasis, and Hess (cited in Cousquer, 2002b) notes that both ivermectin and selamectin have been used safely in rabbits, with ivermectin being specifically recommended and licensed. Fipronil has been discussed for the treatment of myiasis but is not licensed in rabbits and has been associated with mortality in rabbits as discussed by Hess (cited in Cousquer, 2006b). With other products being licensed, the use of fipronil would not be advocated under the cascade.

Prevention of myiasis

Good husbandry is the key to the prevention of myiasis. A rabbit needs adequate space in which to stretch out fully, stand on its hind legs and hop three times in succession as a minimum requirement (Meredith & Crossley, 2002). Access to natural, outdoor, grassy environments is also necessary. Rabbits should be able to perform natural behaviours whilst kept as pets and should have areas of privacy and bolt holes available to access if needed. Separate nesting, living and toileting areas should be provided (Meredith & Crossley, 2002), and all rabbits should be given the opportunity to graze ad-lib during the



Figure 5. An obese rabbit

day in order to meet the requirements of their complex digestive system.

Rabbits are hind-gut fermenters, requiring a low-quality, high-fibre diet consisting mainly of grass (Meredith & Crossley, 2002) (Figure 5). Free access to root vegetables, leafy greens, high-quality hay and grass should be provided in abundance and can completely eliminate the requirement for any concentrate feed (Agar, 2001). If however, concentrate feed is required, muesli-type food mixes must be avoided due to the potential for selective feeding predisposing dental disease and obesity. Single-pelleted dry foods will offer balanced nutrition and adequate levels of protein, fibre and roughage. Agar (2001) recognises the link between poor diet and the occurrence of dental disease and obesity in rabbits, both of which are known precursors of myiasis.

Cyromazine is an insect growth regulator and can be used to prevent myiasis through its action on initial-stage larvae (Cousquer, 2006b). It cannot, however, be applied to broken skin and so should be used for the prevention of myiasis and not as a treatment when there is significant tissue damage. The insecticide permethrin is available for the prevention of parasite infestation, including flies in rabbits, although a study by Birke, Molina, Baker, Leonard, Marrero, Johnson, & Simkin, (2009) observes that although the use of permethrin-based products is effective in the treatment of parasite infestations, selamectin has a more rapid action.

Conclusion

Further research is needed to ascertain the most effective preventative treatments for rabbits predisposed to myiasis. Licensing of selamectin, subsequently increasing owner use, could prove beneficial in preventing parasites in pet rabbits, as discussed by Mellgren and Bergvall (2008).

It would be useful to discover how many practices actively educate and encourage owners to prevent myiasis by incorporating advice on rabbit health, nutrition and living needs into routine appointments or nurse clinics. Understanding and awareness of the condition is needed and should be promoted all year round so owners can prepare accordingly for the hotter months. Television and radio campaigns alongside effective marketing by both the veterinary and pharmaceutical industry could be increased, helping to achieve this.

Nylon netting surrounding rabbit hutches and runs could be advocated in the future as a method of preventing bottle flies entering the accommodation of rabbits.

Successful treatment of myiasis involves a number of different aspects of nursing care and no single element should be overlooked or excluded. Underlying causes of myiasis must be established and treated accordingly. Rabbits requiring anaesthesia may well benefit from combination anaesthesia with the inclusion of inhalant gases if required. Careful monitoring, especially of body temperature, whilst under anaesthetic is imperative, alongside analysis of blood glucose. All patients should receive adequate analgesia due to the limited external signs of pain displayed in the species.

All practitioners should be aware of available, advocated treatment methods for myiasis, including appropriate usage and dilution of skin disinfectants, the advantages of hydrogels and inclusion of vapour-permeable dressings.

It is essential that owners of pet rabbits undertake twice-daily checks of their pet and are aware of the potential risks associated with faecal clumping and urine scalding. If present, they must seek veterinary assistance immediately to determine the underlying cause.

Acknowledgements

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