Proceedings of the 33rd World Small Animal Veterinary Congress

Dublin, Ireland - 2008

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RINGWORM - WHAT’S NEW?
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A presumptive clinical diagnosis of dermatophytosis can be confirmed with cytology (spores on hair shafts), fungal culture and histopathology. Fungal culture is helpful for the formulation of a treatment plan.

The organisms

Dermatophyte types

A diagnosis of dermatophytosis can be made based on the identification of spores on hair shafts in fresh samples and also in stained tissue sections (histopathology). The exact speciation of the type of organism allows an epidemiologically informed prognosis to be made, it does however require a fungal culture. Microsporum canis is frequently isolated from dogs, cats and guinea pigs, in most parts of the world. M. gypseum and Trichophyton mentagrophytes are also not uncommon findings. Small animals and small humans are the most common reservoirs for M. canis. The typical hosts for T. mentagrophytes are rodents and humans. Microsporum gypseum, as a geophilic fungus is a soil contaminant and thus has a lower zoonotic potential. For those small animals which live on a farm, or a renovated farmland, there are also some large animal dermatophytes of which we should be aware. We associate T. verrucosum with cattle, T. equinum with horses, M. nanum with pigs and M. canis with cats (but also dogs and humans and horses). When, in small animal practice, dermatophytosis is suspected, it is important to question the owners about the environment and in particular the potential for previous farm animal contamination.

When a dermatophyte species - which is typically associated with another domestic animal - is isolated, one should assume a pocket of environmental contamination (such as old brushes or equipment) is present. When T. mentagrophytes - a species that is typically associated with rodents is identified, yet no ‘pocket pets’ or their cousins are in the house, then one must rule out a primary human source of infection. In humans this fungus is frequently associated with groin and interdigital dermatitis. When M. canis is identified, the local cats will be blamed, but do not forget to ask if there has been an outbreak of any sort of dermatitis at the kindergarten.

Growth characteristics

Dermatophytes feed on keratin. They have a characteristic pattern of growth, spreading from infected hair shaft to adjacent non-infected hair shaft in a radial fashion. This forms the characteristic clinical ‘ring’ of papules, crust and alopecia which with time is filled with a central regrowth of non-infected hair shafts. Sampling for either histopathology or hair plucks must be from the leading outer edge of the lesions. Crusts frequently contain infected hair shafts embedded within them. These are of particular use to sample for histopathology, but prior to culture or in KOH processing the crusts may need to be macerated in order to free the hair shafts from the frequently thick serous ‘cast’ which can encase them and ‘lock the spores away’. One important part of an actual treatment plan is to recognize that the spores are on many of the hair shafts which are being currently shed by that animal. Clipping and disposal of the removed hairs can reduce environmental contamination.

One important feature of the dermatophyte’s epidemiology which is not identifiable in the laboratory however, is its virulence. Not every M. canis is the same. Some of them are highly virulent, spreading via fomites to rapidly infect all the immunologically naive contact animals and trigger a severe, generalized dermatitis. Others will spread slowly, with milder form of local crusting.

So the species of the fungus, virulence and the environment can all play a significant role in the course of a dermatophyte infection and need to be considered in the formulation of a treatment plan.

The individual

Clinical lesions

The individual clinical lesions of dermatophytosis are identical to those of a staphylococcal folliculitis, with initial scale-crust, focal crusted papules and alopecia extending radially. Later lesions include serocellular crust, fistulae/nodules/plaques and more widespread alopecia. The classic annular lesion of radiating alopecia with erythema and crusted papules at the leading edge ... and a central regrowth of normal hair (i.e. ringworm) can however also be seen with bacterial infections. Indeed the two frequently occur together. One of the more common reasons for a clinical failure is not that the fungus has failed to respond to treatment, but that the secondary bacterial folliculitis has not been treated. Dermatophytosis lesions may be painful, but they are more frequently associated with pruritus. Whether this is due to the (frequent) presence of eosinophils drawn into areas in the dermis with free keratin (furunculosis) is unclear. The degree of pruritus can lead to self trauma and a worsening of the lesions.
Dermatology

Differential diagnoses
The major differential diagnoses for dermatophytosis include those diseases which produce multifocal areas of alopecia, scale, papules and crusts. These include allergies (atopy / food hypersensitivity) with secondary pyoderma, insect bite hypersensitivity with or without secondary pyoderma, demodecosis and uncommonly pemphigus foliaceus. Surface cytology and skin scrapings as well as fungal cultures are indicated in all cases of equine dermatitis which present with scaling, crusting and alopecia.

Diagnosis

Dermatophyte culture
A dermatophyte culture is indicated whenever there is a clinical suspicion of a dermatophyte infection, but is especially indicated when there are children or immunosuppressed individuals in contact. Hairs and scale should be taken from the leading edge of a lesion.

Sabouraud’s agar is the most common medium for fungal cultures. The common, 'in practice' use by most practitioners of dermatophyte test medium (DTM) has advantages but is certainly not as accurate as a culture performed by an experienced mycology lab. DTM is a Sabouraud agar with a color indicator and added ingredients to inhibit growth of saprophytes and bacteria, these additives can also inhibit sporulation and growth of some dermatophytes. A pH change (and subsequently color change) that occurs as the colony is growing indicates dermatophyte growth.

Treatment

Formulating a treatment plan
In both small and large animals, dermatophytosis is usually a self-limiting disease with spontaneous remission occurring within 1-3 months. Thus a symptomatic and simple therapeutic approach including: clipping, topical therapy (thiadiazole/ miconazole/ 1% chlorhexidine/ povidone-iodine/ lime sulfur solution/ 0.2% enilconazole - see below) and appropriate isolation and sanitation may be all that is required for successful resolution in many cases.

However, when successful treatment also includes a minimization of any further spread, then the potential source of the infection, the individual animal and the environment all need to be considered. Dermatophytes are zoonoses and may produce a nasty dermatitis in the contact humans - especially children. Childrens’ pets therefore make a somewhat special case when formulating a therapeutic plan.

Identification of the source
The initial step in most cases is to perform a fungal culture in all in contact animals using the McKenzie toothbrush technique to identify any in-contact carrier or infected animals or humans. Where rodents may be involved, storage of the grain-feed, feeding habits and general cleanliness will need to be reviewed. When the culprit appears to be a newly introduced animal, the epidemic is likely to be almost over by the time it is fully diagnosed and a careful environmental clean-up will be all that remains to instigate.

Selection of treatment agents

Local therapy
Any number of local therapies are available. These can be simply broken down to creams / lotions, antiseptic agents and specific antifungal rinses. The use of highly effective anti-fungal creams and lotions (e.g. terbinafin) in human medicine is not so frequently embraced in veterinary medicine due partly to the presence of a hair coat which inhibits early recognition of lesions and partly to the expense.

Antimycotic veterinary creams/lotions using 'tried and true' but still highly effective ingredients such as miconazole are available, and may be all that is needed for a localized case. The inclusion of cortisone in these medicaments is often helpful in reducing the degree of self trauma and when used sparingly, probably does not significantly inhibit the local immune response. Because a cell-mediated immunity is important for the resolution and long-term induction of immunity, these lotions should be used sparingly.

In general when treating animals topically a whole body treatment (bath or rinse) is to be recommended, as this ensures that the infected, but non-lesional skin and hairs also receive treatment.

In one study, treating infected hairshafts with lime sulphur and enilconazole resulted in negative fungal cultures after 2 treatments; chlorhexidine and povidone-iodine required 4 treatments; ketoconazole and sodium hypochlorite required 8 treatments.

Other topical antiseptic agents available include:

- Chlorhexidine shampoo combined with miconazole: available as Malaseb® (also in other newer shampoos). Caution: chlorhexidine will produce corneal ulcers if allowed to contact the cornea, a pre-treatment with an ocular lubricant ointment is recommended if the lesions and shampoo therapy will be on the head.
- Enilconazole is effective, but can also create local irritation. It has been trialled in cats, although its use is 'off-label'.
- Iodophors are fungicidal and importantly... sporicidal. They are converted to elemental iodine and so are occasionally irritating to animals with a sensitivity to iodine. They can also stain.
- Lime sulphur is a potent fungicidal agent (following breakdown to pentathionic acid) but its pungent odour and jewellery staining precludes its usage by most...
clients and veterinarians. The special shampoos which have been formulated minimise these unpleasant effects.

**Environmental control**

- Sodium hypochlorite is fungicidal and is the cheapest of all agents. It is used as household bleach and will bleach carpets and clothing and occasionally the animal’s hair coat. It will also pit and rust metals following repeated use and it may be carcinogenic.

- Fumigation of the buildings can be considered in Europe and Canada, where an enilconazole ‘fogger’ is marketed for poultry houses, which can be set off in an enclosed area and is an effective sporicidal agent. This is not available in the US or Australia. Fumigation or disinfection should only be applied after thorough vacuuming to remove fragments of hair or other exfoliated keratin which may harbour spores. The contents of the vacuum cleaner must be carefully wrapped and disposed of to avoid further contamination. The fomites, other buildings and transport vehicles must also be subjected to the same treatment.

**Vaccine therapy**

Dermatophytes induce both an immediate, antibody response and a cell mediated immunity which has a long (lifelong?) memory. Within a few weeks of exposure, a healthy individual should already be mounting an appropriate immunological response to a current infection. The administration of a concurrent vaccine in the face of an individual animal’s infection is of questionable value as the time of response to a vaccine is no different to the time of response to a natural infection. However, this immune response is utilized in cattle in endemic areas with the *Trichophyton verrucosum* vaccine. An apathogenic, modified live vaccine of *T. verrucosum* has been used prophylactically in cattle in the Soviet Union and Scandinavia, where intramuscular vaccination of calves at one and three weeks of age confers nearly 100% protection. Localised injection reactions and fever are seen, and occasionally diarrhoea, dyspnoea and anaphylactoid reactions. Protection (only against *T. verrucosum!!*) lasts 4-5 years. A new vaccine has been developed in small animal medicine and may be indicated in situations such as catteries.