Dermatophilus congolensis - ETIOLOGY OF 'PODODERMATITIS' IN KERALA

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Dermatophilosis is a contagious bacterial skin infection of domestic, aquatic and wild animals caused by *D. congolensis*. This condition is commonly known as rain rot, rain scald, lumpy wool disease, strawberry foot rot, and cutaneous streptotrichosis (Kingali *et al.*, 1990; Quinn *et al.,* 2011). Dermatophilosis has been reported by the Food and Agricultural organization (FAO) to be one of the four major bacterial diseases which affect cattle and other animals in the tropical and subtropical regions (Hashemi Tabar *et al*., 2004). Dermatophilosis has been reported from different states in India (Pal, 1995)

A peculiar type of dermatitis on the skin of legs of cattle called as "pododermatitits characterised by matting of hairs, scab formation and cracks or fissures on the skin of legs was reported more frequently among cattle during the recent years in Kerala. Even though the disease is not fatal, it causes severe economic losses to cattle farmers through inferior quality of hide, reduced milk production, weight loss, cost of treatment and culling of severely affected animals. In severe form of disease there will be oedema, pain and lameness and results in loss of production, secondary complications due to bacterial infections or myiasis. The disease was presumed to be of multifactorial aetiology in which a wide range of factors were suspected. But recent studies conducted on this leg dermatitis in cattle revealed the etiology of the condition as *Dermatophilus congolensis* (Tresamol, 2012). The epidemiology, pathogenesis, clinical signs, treatment and control of dermatophilosis is discussed here.

ETIOLOGY

Dermatophilus congolensis belongs to the class actinobacteria, order Actinomycetales, family *Dermatophilacae.*. It is a gram-positive, non-acid fast facultative anaerobic actinomycete. It has two characteristic morphologic forms.-filamentous hyphae and motile zoospores. The hyphae are characterised by branching filaments of one to five micrometers in diameter that ultimately fragment by both transverse and longitudinal septation in to packets of coccoid cells. The coccoid cells mature in to flagellated ovoid zoospores of 0.6 to one micrometer in diameter. Mature zoospores produce germ tubes which develop in to filaments of 0.5 to 1.5 µm in width. Within these filaments transverse and longitudinal divisions form segments that ultimately develop into zoospores. Mature filaments may be more than five µm in width and contain columns of zoospores which impart a tram track appearance to the filaments (Quinn *et al*., 2011). *D.congolensis* was first described by a Belgian Veterinarian and researcher, Van Saceghem from an exudative dermatitis in cattle in the Congo and named the condition "demite granulese" (Van Saceghem, 1915).

EPIDEMIOLOGY

Dermatophilosis is found throughout the world but is most prevalent in tropical and subtropical regions, where it constituted a significant problem in the livestock industry. Endemic and epidemic infections with *D. congolensis* were more commonly reported in cattle, sheep and horses. It has also been reported in dogs, cats, donkeys, wild animals, reptiles and aquatic animals. Animals of different ages and both sexes are susceptible. Animals may have hereditary predisposition to dermatophilosis infection which is a breed rather than individual characteristic and the degree of resistance varied from breed to breed, ranging from extreme susceptibility to complete immunity under normal conditions (Zaria, 1993).

High ambient temperature, rainfall, humidity, ectoparasites, intercurrent diseases, malnutrition and stress play important role in the course, spread and resolution of the disease. The geographical distribution of organism and its ability to cause serious outbreaks during rainy season show the presence of an association between the disease outbreak and heavy rainfall which accelerated the spread and increased the severity of the disease by skin damage, the release and increase in the motility of infective zoospores (Edwards *et al*., 1985). Humidity causes the release of infective motile flagellated zoospores. The low rate of carbon dioxide results in absorption of zoospore while high concentration of carbon dioxide causes release of them (Scott, 1988). Host, age, genetic factors and immunosuppression related to tick infestation have been associated with increased susceptibility to dermatophilosis in ruminants (Ambrose, 1996; Maillard *et al*., 2003; Norris *et al*., 2008). Different breeds of cattle varied in their susceptibility to dermatophilosis and imported crossbred cattle are having the least resistance to dermatophilosis.

The organism can survive for months

Plates

Dermatoplilosis lesions on lowerlimbs with matting of hairs and thick scabs

in dried scab and be transmitted to animal through contact. Infection with *D. congolensis* occurs when the integrity of skin is impaired, as in long exposure to rain or traumatic injuries resulting from arthropod bites. Flies, biting flies and other biting insects have been incriminated in transmission of *D. congolensis* infection. The infection from one part of the body to another can occur through mechanical transmission by flies and ticks.

PATHOGENESIS

Dermatophilus congolensis exists as a skin commensal or saprophyte and is not able to cause an infection until the skin is damaged. The bacterium invades the cutaneous abrasions and initiates an inflammatory reaction characterised by formation of a thick crust. The disease represents essentially an exudative dermatitis with extensive scab formation, the crust adhere firmly to the affected skin and are further held in place by hair fibres. The formation of thick scabs in infections was caused by repeated cycles of invasion and multiplication of the organism in to the epidermis, rapid infiltration by neutrophils, regeneration of epidermis and invasion in to regenerated epidermis.

Dermatophilus congolensis synthesizes a large number of products including exoenzymes such as proteases, keratinases and

ceramidase that may have a role in virulence and pathogenesis. When the organism overcomes the barriers of the skin, the invasive filamentous form grew fungus like through the epidermis (Garcia-Sanchez *et al*., 2004). Hyphal penetration causes an acute inflammatory reaction. In most acute infections the filamentous invasion of the epidermis ceases in 2-3 week and the lesions heal spontaneously. In chronic infections the affected hair follicles and scabs are the sites from which intermittent invasions of non-infected hair follicles and epidermis occur. In wet scabs moisture enhances the proliferation and release of zoospores from hyphae. Dermatophilosis is usually localised to the skin, but invasion in to deeper tissues has been reported to involve lymph nodes, muscles and subcutaneous tissues (Burd *et al.*, 2007).

CLINICAL SIGNS

The disease in cattle is a chronic dermatitis which become visible where the hair on affected part of the skin is matted with exudates which harden when dry, presenting paint brush appearance. The lesions also appear as tiny scabs or irregularly outlined areas of scabs formed by the coalescing of several small scabs. The lesions can occur in any part of the body and occasionally become generalised. Distribution of lesions in cattle usually correlated with the predisposing factors that reduced or permeated the natural barriers of the integument. Localised infections are usually of little consequence. Lesions may resolve spontaneously within a few weeks particularly in dry conditions. In severe infections lesions may be extensive and death may occur particularly in calves. Investigations on dermatophilosis in Kerala (Tresamol, 2012) revealed that the lesions were found to occur on various parts of the body, but were most common on lower part of hind limbs and forelimbs. The other common areas affected were udder, inguinal region, perineum and ventral abdomen. Severe and generalised form of disease was seen in animals in advanced stage of pregnancy or in early lactation.

DIAGNOSIS

Diagnosis of dermatophilosis depends largely on the appearance of lesions in clinically diseased animals and demonstration of organism in stained smears or histologic sections from scabs. In stained smears of clinical specimens *Dermatophilus* was usually seen as the characteristic branched filament with parallel rows of zoospores; however organism may be seen in any form of the various stages of its lifecycle. The scabs in the active stages of *D. congolensis* infection, which were difficult to remove, were the suitable material for laboratory examination. It is also found that Giemsa staining method was found to be superior to methylene blue and Gram's stains because it demonstrated more detailed morphology with in hyphae.

Histopathological findings include congestion and oedema of dermis, degeneration, necrosis and hyperkeratosis of the cells in the epidermis. There will be accumulation of exudates on the surface of the skin and infiltration of neutrophils in the dermis and epidermis. *Dermatophilus s*howing branching septate filaments or coccoid zoospores are found in epidermis down the stratum basale

Isolation and Identification of *D. congolensis* on bacteriological media and use of biochemical reactions were widely employed for confirmatory diagnosis of dermatophilosis. Sheep blood agar is most commonly used and incubation should be done in presence of 10 to 20 per cent carbon dioxide for 24 to 48 hours. Haalstra (1965) described a method for cultural isolation of *D. congolensis* by which the contamination with other bacteria could be reduced. Colonies of *D. congolensis* are greyish yellow, distinctly haemolytic and are firmly adherent to the medium and are embedded

in the agar. After three to four days isolated colonies are rough, wrinkled and golden yellow in colour. Older colonies can become mucoid. Gram stained smears from colonies may not show the characteristic tram-track appearance. Usually the smears reveal uniformly staining gram positive filaments, but sometimes coccal forms predominate (Quinn *et al*., 1994). The isolates are positive in tests for motility, catalase, oxidase, urease, gelatine hydrolysis, starch hydrolysis and digestion of Loefflers coagulated serum. They show negative reaction in tests for nitrate and indole. Variable results were reported in sugar fermentation tests. Several serological tests employing crude components of *D. congolensis* were utilised to study the immune response such as hemagglutination test, complement fixation test, fluorescent antibody techniques and counter immune electrophoresis. Polymerase chain reaction was also used for detection of *Dermatophilus congolensis* in clinical specimens (Han *et al.,* 2007; Shaibu *et al*., 2010).

TREATMENT

Several antibiotics and topical preparations were reported to be effective in the treatment of dermatophilosis with variable levels of success. There is no single treatment that is considered specific for dermatophilosis. It is important to remove scabs and facilitate contact of medication with the organisms. Topical agents such as tincture of methyl violet, Tincture of iodine (2 to 7 per cent), raw linseed oil, iodoform ointment, copper sulphate, and many other proprietary antiparasitic, bactericidal and fungicidal formulations were claimed to be effective. A number of parenteral antibiotics were effective in treating the disease (Sutherland, 2008). Tetracycline (5mg/kg BW) repeated weekly as required or long acting oxytetracycline (20mg/kg bw) in one injection is recommended (Radostits *et al*., 2007). Procaine penicillin combined with streptomycin at doses of 70000 units/kg and 70mg/kg respectively is also found to be effective. Clinical trials with different topical preparations, parenteral antibotics and their combinations revealed that, better and rapid cure was observed with a combination of parenteral antibiotic and topical application of Tr. iodine and glycerine. In a clinical trial when the treatment response with three antibiotics was compared better response was found with ciprofloxacin and oxyteracycline compared to penicillin streptomycin combination (Tresamol, 2012). Failure of treatment in some cases may be because of the inability of topical antibiotics to reach the organism in the deep epidermis or inability of parenteral antibiotics to reach the avascular upper epidermal layers. Spontaneous healing is known to occur in relatively mild cases (Zaria, 1993).

Tram-track appearance of *D. congolensis*

CONTROL

Isolation and treatment of clinically affected animals, culling of chronically affected animals, protection from the persistent moisture conditions and controlling ectoparasites are the methods to break the infective cycle (Kahn, 2005). Animal breeders have observed that dermatophilosis susceptibility seemed to be determined genetically. Recently new control

methods based on identification of molecular genetic markers of resistance or susceptibility to dermatophilosis in cattle was developed. Research is continuing on increasing the resistance of cattle and sheep to infection by methods for modifying the microbial populations of the skin in order to reduce the potential of *D. congolensis* for invasion (Norris *et al*., 2008). Vaccines said to be effective against dermatophilosis in cattle have been produced in Africa. Vaccines produced against dermatophilosis in sheep have resulted in earlier resolution of lesions and less severe disease, but not complete protection (Sutherland, 2008).

ZOONOTIC SIGNIFICANCE

Human dermatophilosis was presented with wide spectrum of manifestations such as pitted keratolysis, pustules, erythematous exudative scaly lesions and fissuring of skin (Kaminski and Suter, 1976; Zaria, 1993). It may cause subcutaneous nodules and hairy leukoplakia in patients with immune deficiencies (Bunker *et al*., 1988). Human infection may be self limiting and regress without treatment although they can recur, especially in wet environment (Ambrose, 1996). Most infections appeared to result from mechanical transfer by direct contact with infected animals that carry *D. congolensis* as a skin commensal. It was also possible that infection may be spread indirectly from debris of infected animals.

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