An Overview on Dermatophilosis of Animals: a Review

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Abstract

Dermatophilosis is a contagious zoonotic skin disease with wide host range and most commonly affects cattle, sheep and horse. The principal causative agent is Dermatophilus congolensis which is a member of the aerobic actinomycete. Dermatophilosis has worldwide distribution and the disease is reported most frequently in relatively low altitude areas with tropical and subtropical climates with high ambient temperature and torrential rain patterns. The disease is characterized by exudative dermatitis with scab formation. Factors such as prolonged wetting by rain, high humidity, high temperature, mechanical injury to the skin, concurrent disease, stress and tick infestation that reduce or permeate the natural barrier of the integument influence the development, prevalence, seasonal incidence and transmission of Dermatophilosis. Diagnosis can be made by demonstrating the characteristic appearance of the cocci on impression smears. Treatment, control and prevention of Dermatophilosis depend on deep understanding of the epidemiology of the disease. As conclusion Dermatophilosis has a worldwide distribution, wide host range and creating an economic significance in animals. So in addition to reviewing the subject matter of Dermatophilosis, an advanced research is required to assess the status of the diseases in detail.

Key words: Dermatophilosis, diagnosis, epidemiology, prevention and control, risk factors.
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Introduction

Dermatophilosis is a contagious zoonotic skin disease caused by members of aerobic actinomycete (Dalis et al., 2010). The exact causative agent of Dermatophilosis is *Dermatophilus congolensis* which is aerobic, actinomycete, a gram positive bacterium that produces motile zoospores (Hirsh et al., 2004). The disease was first reported by von-soochezem (1915) in cattle in the Belgian Congo (Shoorijeh et al., 2008). Eventhough the disease affects a wide variety of animals and occasionally humans, the most commonly affected species are cattle, sheep and horses and rarely dogs and cats in many parts of the world (Dejene et al., 2012).

The disease in cattle and sheep is commonly called cutaneous streptotrichosis and mycotic dermatitis respectively, and in horse rain scald, although other local names exist including senkobo skin disease in central Africa, kirchi in nigeria, and saria in malawi. Dermatophilosis is a name common to the disease in all species (Radostits et al., 2007).

The disease is non pruritic, and is characterized by exudative, proliferative or hyperkeratotic dermatitis, accompanied by the production of crusts and folliculitis. It invades the skin and causes skin disease (Yeruham et al., 2003). The disease had been reported to be more severe in ruminants and was of particular importance in tropical and subtropical regions (Andrew et al., 2003).

Several factors are involved in the pathogenesis of Dermatophilosis; among them are mechanical injury to the skin, rainfall, tick infestation, concurrent diseases and stress that compromise the host immune system. It is generally accepted that in the rainy season, owing to devitalizing effect on the skin barriers, the high relative humidity has a significant influence on the maturation and motility of the infective zoospores, and it has been claimed to be a major predisposing factor in the spread and epidemiology of Dermatophilosis (Yeruham et al., 2003).

The organism can exist in quiescent form with in the epidermis until infection is exacerbated by climatic condition. Epidemics usually occur during the rainy season (Hirsh et al., 2004). Shearing, dipping, or introducing an infected animal in to a herd or flock can spread infection. The disease is transmitted by direct contact with infected animals or indirectly via contaminated objects or flies (Quinn et al., 2002). Moisture facilitates release of zoospores from preexisting lesions and their subsequent penetration of the epidermis and establishment of new foci of infection. High humidity also contributes indirectly to the spread of lesions by allowing increases in the number of biting insects particularly flies and ticks, that act as mechanical vectors (Radostits et al., 2007).

Diagnosis made based on clinical appearance of the lesion on the affected animal and demonstrating the causal organism from the lesions beneath the scabs (Kahn, 2005).

The outcome of treatment is influenced by the severity and extent of lesions. Parenterally administered antibiotics such as long acting oxytetracyclines are usually effective (Awad et al., 2008). Control and prevention measures are based on minimizing the effect of predisposing factors and early treatment of clinical cases (Quinn and Markey, 2003).

The disease often creating economic problems by creating severe skin matting resulting in hide depreciation, overall decrease in animal productivity and severe case mortality in susceptible weak animals (Stewart, 1997).

Therefore, the objective of this seminar paper is:

To review the epidemiology, prevention and control aspects of Dermatophilosis.

Literature Review

Etiology

*Dermatophilus congolensis* is a gram positive, non acid fast, aerobic actinomycete. It has two characteristic morphologic forms: filamentous hyphae and motile zoospores. The hyphae are characterized by branching filaments (1-5µm in diameter) that ultimately fragment by both transverse and longitudinal septation in to pockets of coccoid cells. The coccoid cells mature in to flagellated ovoid zoospores (0.6-1µm in diameter) (Andrew et al., 2003).
Epidemiology

Geographic distribution: Dermatophilosis occurs in all areas of the world and can be epizootic in tropical and subtropical areas of the world (Dalis et al., 2010 and Radostits et al., 2007). Survey of large number of cattle in Africa revealed prevalence rates approaching 15% with a 100% infection rate in some herds at the time of peak seasonal prevalence. In temperate climates the disease is usually sporadic but can still have considerable economic importance where predisposing factors pertain (Radostits et al., 2007). High prevalence in sheep flock occurs in high and medium rainfall areas (Aitken, 2007).

Host range: Dermatophilosis occurs in cattle, sheep, goat, horse, dog, cat, donkey, human, and occasionally in deer, pig, camel, and wild life species (Quinn et al., 2002).

Source of infection: The principal source of infection for Dermatophilosis is the infected animals, including the healthy carrier and the apparently recovered animals. In endemic areas, up to 50% of apparently healthy cattle may be carrier of the bacterium, while persist in the ostie of hair follicles (Jubb et al., 1992). *Dermatophilus congolensis* is not highly invasive and does not normally breach the barriers of healthy skin. These barriers include the sebaceous gland on the body of sheep and the physical barrier of the wool. On the feet and face these barriers are easily and commonly broken by abrasive terrain or thorny and spiny forage and food stuffs. *Dermatophilus congolensis* may infect these lesions and may be transmitted mechanically by feeding flies to result in minor infection on the face and feet. This carriage form of the disease is common in most herds and minor lesions are evident at the junction of the haired and non haired areas of the nares and of the claws and dewclaws. They are no of clinical significance to the animal except that they provide a source of more serious infection when other areas of the skin surface are predisposed to infection (Kahn, 2005).

Mode of transmission: Transmission occurs from the carriage lesions by contact from the face of one animal to the fleece or skin of another, and from the feet to the skin during mounting. Dermatophilosis is transmitted by the cocoid forms, which results from the multidimensional division of the hyphae known as a zoospore. The zoospore is motile and released when the scabs are exposed to moisture. Transmission can be direct or indirectly through contaminated water or grass. Insect transmission which has been demonstrated with flies and ticks is believed to be a principal means of spreading zoospores (Quinn et al., 2002).

Risk factors: Environmental and managerial factors

Cattle: In temperate zones, outbreak in herds and severe disease in individuals are uncommon but can occur associated with high rainfall with attack rate of 50%. The use of periodic showers or continual misting to cool cattle during hot periods is a risk factor for infection in dairy herds (Radostits et al., 2007).

In tropical zone, climate is the most important risk factor in tropical and subtropical regions. For example, rain fall can act indirectly to increase the range and activity of potential arthropod vectors. These arthropod vectors are important in the endemic tropical and subtropical areas than in temperate zones (Jubb et al., 1992 and Radostits et al., 2007). The disease has highest incidence and severity during the humid and high rainfall season. The seasonal occurance is associated with concomitant increase in tick and insect infestation. (Radostits et al., 2007).

Tick infestation, particularly with *Amblyomma varigatum*, *Hyaloma asticium*, and *Boophilus microplus*, is strongly associated with the occurance of extensive lesions of Dermatophilosis, which can be minimized by the use of Acaricides. The lesions of Dermatophilosis on the body does not occur at the predilection sites for ticks and it is thought that the importance of tick infestation relates to a tick produced immune suppression in the host rather than mechanical or biological transmission (Kahn, 2005).

There is a particular tendency for lesions to occur on the rump and back in female and males probably due to the introduction of infection through minor skin abrasions caused by mounting, other penetrating lesions caused by ear tags or biting flies can also result in minor lesions. Intercurrent disease, stress and trauma to the skin
produced by thorny bushes can act risk factors (Radostits et al., 2007).

Sheep: Prolonged wetting of the fleece is the major risk factor and lead to emulsification of the wax barrier and maceration of skin surface with disruption of the stratum corneum. A prolonged and heavy rain is sufficient to do this especially if followed by warm and humid weather that retards drying of the fleece. Increased environmental humidity and temperature, as distinct from wetting of the skin, does not appear to promote the development of lesions. Moisture releases infective zoospores from carriage lesions and these may be carried mechanically by flies which are attracted to the wet wool. The motile zoospores are aided in their movement to the skin surface by the moisture of the fleece and their positive chemotactic response to carbon dioxide at the skin surface (Aitken, 2007).

A protracted wetting period of the fleece can also occur following dipping, jetting, or spraying of sheep for external parasites when these procedures are conducted at periods greater than 1-2 months after shearing; the incidence of mycotic dermatitis in sheep has been shown to increase with the time period between shearing and dipping. Shearing also destroy the barriers of the skin and cuts may become infective mechanically by flies, physically by tight yarding after shearing, and mediate infection in dips when sheep are dipped immediately following shearing. The resultant lesion does not spread over the body but provide a significant source of infection for other sheep in the flock when management or climatic circumstances lead to a high degree of flock skin susceptibility (Aitken, 2007).

Horse: Biting flies (Stomoxys calcitrans) are thought to act as mechanical vectors of the infection and House fly (Musca domestica) can carry infection. Skin damage from trauma or from ectoparasites can predispose disease as does wetting from rainfall or from frequent washing (Reed et al., 2004).

Host factor

There is breed differences in susceptibility to Dermatophilosis. In Africa, the N’dama and Muturu cattle breeds and native sheep are resistant, while Zebu, White Fulani, and European breeds are susceptible. Within breed differences in susceptibility are also apparent and genetic markers have been identified in Zebu. Susceptibility in cattle can be influenced by genetic selection. Sheep that have strong or medium wool strains are most susceptible. Open fleeced sheep and sheep with a low wax and high suint content in their fleece are more prone to infection (Radostits et al., 2007).

Pathogen factor

Dermatophilus congolensis does not live well off the body and in the normal environment, and is susceptible to the external influences of PH and moisture fluctuations. In the laboratory it can survive for four years otherwise sterile broth culture and for at least 13 years in dry scab material (Radostits et al., 2007).

Pathogenesis

The natural skin serves as effective barrier to infection. Minor trauma, or maceration by prolonged wetting, allows establishment of infection and multiplication of the organism in the epidermis. The formation of typical pyramidal shaped crust is caused by repeated cycles of invasion in to the epidermis by hyphae, bacterial multiplication in the epidermis, rapid infiltration of neutrophils, and regeneration of epidermis. The organism in the scab is the source for repeated and expanding invasions which occurs until immunity develops and the lesion heals. The scab then separates from the healed lesion but is still held loosely in place by hair fibers. In sheep, the extensive maceration of the skin that can occur with prolonged fleece wetting can result in extensive skin lesions under the fleece. In cattle, tick infestation suppresses immunity function and promotes the spread of the lesion. Secondary bacterial may occur and give rise to extensive suppuration and severe toxemia (Jubb et al., 1992).

Clinical Findings

Dermatophilosis is seen in animals at all ages and both sexes are also susceptible to infection (Haward, 1996). In cattle, the lesion commences as a circumscribed moist patch, often with raised or
matted hairs, giving a characteristic “Paint brush” appearance. Discrete lesions occur in the initial stages which coalesce to form large areas of hyperkeratotic scab and crust. Distribution of the gross lesion usually correlates with the predisposing factors that reduce or permeate the natural barrier of the integument. Typical lesions consists of circular, dome shaped scab 2-9cm in diameter. Scab may be of variable thickness and on removal show a concave underside coated in thick, yellowish exudates, leaving a row, bleeding epidermis (Andrew et al., 2003). Death usually occurs particularly in calves because of generalized disease with or without secondary bacterial infection and secondary fly or screw worm infestation (Kahn, 2005).

In sheep, lesions are not commonly visible because they are obscured by the fleece but crusts can be palpated as hard mass at the surface of the skin. Heavy mortalities can occur in very young lambs where there can be extensive lesions over the body (Aitken, 2007).

Lesions in horse are similar to those in cattle, the lesions are matted together over the lesion and an exudative dermatitis produces a firm mat of hairs and debris just above the skin surface. If this hair is plucked the entire structure may lift off, leaving a characteristic ovoid, slightly bleeding skin area (Reed et al., 2004).

Clinical pathology: The causative organism may be isolated from scraping or a biopsy section and is much easier to isolate from acute case than chronic ones (Jubb et al., 1992). Typical branching organisms with double row of zoospores can be seen in a stained impression smear made directly from the ventral surface of a thick scab preserved firmly on to a slide. The organism can be also demonstrated by fluorescent antibody test (FAT), enzyme linked immuno sorbent assay (ELISA) and counter immuno electrophoresis (CIE) also been used to detect serological evidence of infection with Dermatophilus congolensis (Jones et al., 1996).

Necropsy finding: In animals that die, there is extensive dermatitis, sometimes a secondary pneumonia, and often evidence of intercurrent disease (Radostits et al., 2007).

Diagnosis

Microbiological methods: Microscopic appearance of the organism: The organism has a characteristic microscopic appearance, it is septate, and its branching filament become longitudinally as well as transversely divided to form ribbons of spherical or ovoid cocci, each about 0.5µm in diameter, in multiple rows. This provided that cocci are found in transverse row of four or more and is readily seen in stained preparations. However, the distinctive formation can be disrupted during the preparation of smears for examination of the material is spread too vigorously over the slide (OIE, 2008).

The characteristic segmenting appearance seen in tissue is often not seen in gram stained smears; these may at times show cocci only, but they usually show gram positive branched filamentous organisms. Motile zoospores can be shown after growth in tryptose broth. Definitive identification is made on the unique appearance in tissues, or the following tests: catalase positive; urase positive; glucose, fructose and maltose positive; indole negative; gelatin positive; sucrose, salicin, and xylose positive (Cullimore, 2000).

Isolation procedures: The organism grows well on blood agar. Plates are inoculated from clean serous exudates or from the lower aspect of moistened scabs. The organism is not fastidious and grows well on un enriched media such as tryptose agar. The organism also grows well in various broth media but, there is no growth on sabouraud dextrose agar (SDA) (Bailey and Scott’s, 2002).

Cultural characteristics: Pin point colonies surrounded by small zones beta hemolysis are evident after twenty four hour incubation at 37°C. After incubation for three to four days, colonies are considerably larger. There may be wrinkled or smooth, convex, and varying in color from grayish white to bright orange (Dalís et al., 2010).

Molecular diagnostic method: Polymerase Chain Reaction; Polymerase chain reaction can be carried out for the detection of the Dermatophilus congolensis genome isolated from the suspected samples. The amplification process requires the following major steps: Template DNA is initially denatured at 95 °C for 1 min followed by
denaturation at 94 °C for 30 sec, annealing at 60 °C for 30 sec and extension at 72 °C for 1 min and a final extension at 72 °C for 7 min. The following elements are also required to prepare the reaction mixture and to run the PCR machine. The known forward primer 5'-ACATGCAAGTGCAACGATGA-3' and the reverse primer 5'-ACGCTCGACCCCTACGTATT-3', magnesium ion as a buffer, dNTPs, Taq DNA polymerase, template DNA, and nuclease free water. Then the PCR products after some cycle are allowed for electrophoresis in an agarose gel (1.5%) containing 10 μL of 10 mg per mL ethidium bromide at 80 volts for 45 min. One hundred base pair DNA marker can be used as a molecular size marker. DNA amplifications were examined and photographed using UV transluminator (Samon et al., 2010).

**Differential Diagnosis**

The differential diagnosis for Dermatophilosis includes Ring worm, Staphylococcal dermatitis/Folliculitis/, Scabies, Pediculosis, and Fleece rot (Sheep) (Radostits et al., 2007).

**Treatment**

The most aspect of therapy involves removal of factors predisposing to infection. Most conditions that result in cutaneous maceration must avoid giving the skin an opportunity to dry out (Smith, 2009). The area where the infected animals have been kept should be either disinfected or abandoned (Smith, 2002).

For cattle, with the disease that occurs in temperate areas Tetracycline (5mg/kg body weight (bw)) repeated weekly as required is recommended and long acting oxytetracycline (20mg/kg bw) in one injection is recommended (Radostits et al., 2007). With the disease that occurs in tropical areas and associated with tick infestation parenteral treatment with antibiotics, can be used and should be used in conjunction with Acaricides (Stewart, 1997).

In sheep, bacterial dips are used, but have limited efficacy as topical treatments do not penetrate the scab to the active lesion and are more appropriate for control. Antibiotics that are effective include procaine penicillin combined with streptomycin at doses of 70000 units/kg and 70mg/kg respectively. Treatment appears effective in wet weather and it should be given prior to shearing (Aitken, 2007).

In case of horses topical therapy is most commonly used with removal from whatever is causing prolonged wetness of the skin. Scabs can be removed by grooming under sedation and the lesions treated topically daily with povidone-iodine or chlorhexidine until the lesion heal. Severe cases can be treated daily for three days with penicillin at 20000 units/kg alone or in combination with streptomycin at 10mg/kg (Reed, 2004).

**Prevention and Control**

The following options are important for the prevention and control of Dermatophilosis as stated by (Radostits et al., 2007; Kahn, 2005; Smith, 2009; Awad et al., 2008; Jubb et al., 1992 and Krauss et al., 2003) respectively.

- Avoidance of skin trauma and of management practices that promote transmission.
- Treatment with antibiotics.
- Infected animals must be carefully groomed to remove crusts that contain the organism.
- The crust must be appropriately disposed to prevent further contamination of the environment.
- Establishment of breeds resistant to Dermatophilus congoensis.
- For humans, use of protective clothing, gloves and personal hygiene.

**Economic and Zoonotic Importance**

In sheep, damage to the fleece causes severe losses up to 30% loss of value of wool and 40% loss of skin value, and may be so extensive in lambs that spring lambing has to be abandoned. Other losses in sheep are caused by interference with shearing and a very great increase in susceptibility to bowl flies (Radostits et al., 20007).

In Africa the disease in cattle causes great losses and many deaths, and the disease ranks as one of the four major bacteriological diseases with equivalent importance to Contagious Pleuro Pneumonia and Brucellosis. Goat in the same area
also suffers a high incidence. Losses are from direct animal loss, decreased work ability of affected oxen, reproductive failure from vulval infection or infection on the limbs of males preventing mounting, death from starvation of calves of dams with udder infection, loss of animal meat and milk production, and down grading of the hides (Radostits et al., 2007).

Humans who are exposed to infected animals or contaminated animal products (example, slaughter house workers, butchers, hunters, dairy farmers, veterinarians) acquire the infection (Kamininski and Suter, 1995). In humans, Dermatophilosis appear as eczemoid cells, multiple pustules, or even furuncles, localized predominantly on the hands and forearms. In most cases, the lesions heal spontaneously within two to three weeks (Krauss et al., 2003).

Conclusion

Dermatophilosis is contagious zoonotic skin disease with wide host range and most commonly affects cattle, sheep and horses. The principal causative agent is *Dermatophilus congolensis* which is a member of the aerobic actinomycete. Dermatophilosis has a worldwide distribution and the disease is reported most frequently in relatively low altitude areas with tropical and subtropical climates with high ambient temperature and torrential rain patterns. The disease is non pruritic and is characterized by exudative dermatitis with scab formation. A number of factors are involved in the pathogenesis of Dermatophilosis. Some of them are trauma or damage to the skin, rainfall, tick infestation and stress that compromise the host immune system. Diagnosis of Dermatophilosis can be made based on clinical appearance of the lesion on the affected animal and demonstrating the causal organism from the lesions beneath the scabs. Parenterally administered antibiotics such as long acting oxytetracyclines are usually effective. The control and prevention measures of Dermatophilosis are aimed at minimizing the effect of predisposing factors and early treatment of clinical cases. Humans can acquire the infection of Dermatophilosis who are exposed to infected animal or contaminated animal products and in most cases the lesions heal spontaneously within two or three weeks. Dermatophilosis often creating economic problems by creating severe skin matting resulting in hide depreciation, overall decrease in animal productivity and severe case mortality in susceptible weak animals.

Therefore, based on the above conclusion the following points are forwarded as recommendation:

- Factors that bring mechanical injury to the skin should be avoided.
- Management practices that promote transmission should be avoided.
- Different epidemiological studies and researches should be undertaken.
- In areas where tick infestation is present acaricides should be given.

References

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