Risks of Transmission of Infection with Species of the Genus Trichophyton from Animals to Humans

Vlad Scripcariu[1], Daniela Moț[1]

[1]*University of Life Sciences "King Mihai I" from Timisoara, Faculty of Bioengineering of Animal Resources, 300645-Timişoara, Aradului, 119, Romania*

Abstract

Trichophytosis (ringworm) is included in the category of dermatomycoses or superficial mycoses, being a fungal infection, produced by a microscopic fungus of the genus *Trichophyton*. Since in recent decades an increase in the incidence of trichophytosis has been observed in humans and susceptible animals, either with asymptomatic or symptomatic evolution, a more detailed knowledge of the important sources of transmission of this disease from animals to humans is still required, for the adoption of more effective parasitological surveillance measures for this dermatophytosis. In this sense, it is necessary to know some aspects related to the morphology, the epidemiological implications and the correct establishment of the diagnosis, but also the choice of effective therapeutic protocols to prevent, treat and combat this dermatomycosis in animals and humans. In this regard, a growing interest has been given in recent years to pets that represent a permanent risk of human contamination, but the evolution of this disease in farm animals cannot be neglected.

Key words: dermatomycoses, fungal infection, *Trichophyton*, Trichophytosis.

1. Introduction

Fungal infections, also called superficial mycoses, affect the superficial layers of the skin, hair and claws in animals, producing sometimes very serious injuries. Dermatophytes are the species involved in the production of skin lesions that mainly belong to the genera: *Tricophyton, Microsporum* and *Epidermophyton* and the diseases caused by these fungi are called dermatophytoses. Diseases caused by dermatophytes but also non-dermatophytes, from the genera *Candida* and *Malassezia* are called dermatomycoses. In the last decades, attention has been increasingly focused on these types of microscopic fungi because the incidence of diseases caused by them in humans and animals of species susceptible to such infections has increased a lot. Because in recent years the attention paid to pets is increasing and the risk of human contamination, both from carnivores with clinical infections and from asymptomatic carriers, has increased a lot. At the same time, animal owners noticed a deterioration in their appearance due to skin, fur and claws injuries following infections with dermatophytes from the *Tricophyton* genera. From the point of view of their preferred habitat, dermatophytes are divided into three large ecological groups: geophiles, anthropophiles and zoophiles. The mode of distribution and their etiology can change over time, in different areas, as a result of the involvement of some factors [1, 2]. These factors can be listed as: migration of populations, hygiene, changes in living standards or travel. A special role in this sense is also attributed to wild animals, such as rodents, being the ones that often make the connection between the rural and the urban environment. When the prevalence of

* Corresponding author: Scripcariu Vlad
Email: vladscripcariu98@gmail.com

infections caused by dermatophytes, especially in carnivores, is observed, it is very varied and under the influence of many factors such as: the number Epidemiological investigations carried out by different authors [2, 4] have revealed a higher incidence of these diseases in cats, two or even three times higher compared to dogs. The sources of contamination in these cases are represented by the animals with clinical signs, the asymptomatic but carriers, the contaminated toilet items used for them, the transport carried out in contaminated means, and the transmission of infections between different species has also been observed. For geophilic species of dermatophytes but also for some zoophilic and anthropophilic species that survive at the soil level, the external environment represents an important source of infection. Infections with zoophilic species in humans can occur either through direct contact with the infected animals, or through indirect transmission with various materials and objects from the external environment. In rural areas, the most frequent dermatophytic infection is caused by *Tricophyton verrucosum* following contact with contaminated cattle. In the urban environment, trichophytic infection occurs in humans following contact with infected pets, most commonly from apartment rodents such as rabbits, mice and guinea pigs, with *Tricophyton mentagrophytes* and *Tricophyton quinckeanum* [5].

1. Etiology

Species of the genus *Tricophyton* form round lesions, all over the body, of variable sizes from one animal to another. Trichophytosis is classified as a disease of squalor, but the evolution in animals with very good maintenance conditions contradicts this statement. In cattle the most common species is *T. verrucosum*, which can also parasitize horses, sheep, rabbits, cats, dogs and humans. Trichophytosis in humans is produced by the species: *T. rubrum*, *T. violaceum, T. tonsurans, T. megninii* and *T. schoenleinii*. The mouse, rat, cat, rabbit, fox, cattle, sheep, and horse most commonly have trichophytosis with *T. quinckeanum*. The monkey gets sick with *T. simii*, the hedgehog with *T. erinacei*, and the birds with *T. galinae, T. ajelloi*, which can also sporadically infect dogs, cats, cattle, horses and humans. The species *T. terrestre*, as its name implies, is frequently found in the soil, from where it can of animals observed, the period of the study, stray animals, those in exhibitions, but also those with or without obvious clinical signs [3].
infect dogs, cats, small mammals and, exceptionally, humans. In humans, dermatophytic infections can be caused by *T. rubrum* (or *purpureum, rubidum, kagawaense*) (Castellani 1902). Non-suppurative trichophytosis in humans is produced by *T. verrucosum*, and suppurative by *T. mentagrophytes* and *T. erinacei* [1, 3].

2. Trichophytosis in animals

In cattle, trichophytosis has a benign evolution, but this disease is of great economic importance, recording very high losses as a result of extensive skin lesions, decreased production, expenses for disease control, treatments and animal movement restrictions that will always have serious consequences on the technological flow in the farms. Most frequently in cattle, the disease is caused by *T. verrucosum*, which has a great capacity to invade the dermis and hairs. In order to produce the disease, the pathogenicity of this dermatophyte is involved in the first place, but other factors also compete that facilitate this. First of all, one of the important factors is the high humidity, the inability to defend through the local and general immune system as a result of the nutritional deficiencies of the animals involved. In cattle, trichophytosis develops as an enzootic, being found in countries on all continents, from those with a warm climate to those with a cooler climate. As in any contagious disease, the main source of infection is represented by sick animals, either those with clinical signs or asymptomatic carriers [6]. The closer the contact between animals and the more extensive the lesions of the sick ones on the body, the faster and easier the disease spreads in large herds of cattle. From the lesions represented by crusts, the spores of this fungus reach the living environment, representing the secondary sources of infection. Even climatic factors such as wind can contribute to the spread of disease from contaminated areas with sick animals to areas with healthy animals. The disease can be spread over great distances and by transporting hair, skins, wool from sick animals. Despite the fact that the lesions last up to two months, due to the skin reaction nodules and trichophytic plaques appear that will contribute to the long-term persistence of the disease, with a

tendency to spread to healthy animals. The disease is easily transmitted both in the stable and in the pasture, an important role being played by contaminated shelters, machinery, objects, air laden with dust contaminated with spores, hay, insects, contaminated or uncontaminated caretakers or rodents, birds or other animals that can carry the infection from one shelter to another. *Tricophyton* spores can survive in the external environment from several months to several years, especially those in crusts, with the optimum temperature range between 20 and 30 degrees Celsius. The transmission of infection depends on food, the presence of other diseases, race, age, sex and season. In our country, trichophytosis can be found both in the Holstein-Friesian, Frisian breeds and in local breeds, such as the Romanian Bălțata or the Brună of Maramureș, regardless of age. The higher incidence of the disease has been observed in youth, which causes more severe forms, while cattle over three years of age have milder forms, which often heal spontaneously. The integrity of the skin is important in the appearance and development of trichophytosis. Calves with skin lesions caused by insect bites, mange or other parasites develop trichophytosis much more easily because the skin's defense barriers against the disease are destroyed. Trichophytosis is more common in autumn, reaching its maximum development in winter, then decreasing in intensity. In shelters with poor hygiene conditions, with animals that are not properly fed, the disease can also be encountered frequently during the summer. Trichophytic lesions can be complicated by the intervention of bacteria, reaching suppurative wounds, with very serious evolution. Animals can show an allergic state to inflammatory trichophytosis, a phenomenon also observed in humans. After passing through the disease, animals remain with a fairly solid state of immunity, which depends mainly on how they are maintained, but also on their physiological state.

The incubation period is 1-3 weeks, after which a small nodule initially appears, which is covered with white crusts and is called a trichophytic nodule. The lesions then enlarges, a very adherent crust appears on the animal's skin, with a stratified appearance, which if removed leaves a bleeding lesion that can become infected very easily. Local hair takes on a light shade because it depigments and breaks very easily. All these finally form a trichophytic plaque that can merge with others and even extend over the whole body. Often these lesions are found on the head, neck, tail, rarely on other body regions. In calves under one year, lesions are most frequently observed on the head and neck, in others they can be observed all over the body (Figures 1-3). In cattle, atypical symptoms of trichophytosis were also observed in cows over two or three years of age, in which circumscribed areas of hairless skin appeared, especially on the sides of the abdomen and chest. These can be sources of contamination of young animals, especially calves, as their lesions may go unnoticed. The treatment of lesions is a rather cumbersome and expensive method for the intensive breeding of bulls, because it requires a lot of time for each animal spent with the restraint, the application of the treatment, its repetition. This treatment is done with three large groups of substances, namely antifungals, and sometimes antiparasitics and antibiotics. Disease prevention is done through a series of measures aimed at carefully examining the introduced animals and keeping them separate from the rest of the animals, with careful daily surveillance. A general treatment with water-soluble antifungal substances can be used. Contact with anything that can represent a secondary source of disease transmission must be avoided. The basis of maintaining the indemnity of the cattle herds is specific prophylaxis, through the administration of vaccines [7]. Trichophytosis in sheep and goats is rarely diagnosed, perhaps because it is often not noticed. These animals can become ill with two species of *Tricophyton: T. verrucosum* and *T. mentagrophytes*. These animals can be contaminated from sick ones or from calves or horses, but also rodents or humans can contaminate them. The presence of ectoparasites in sheep and goats can favor the appearance of the disease by creating lesions in the skin where *Trichophyton* spores penetrate more easily. The disease often occurs in sheep and goats from the age of 3-4 months up to 2-3 years. Lesions appear on the ears, from where they spread around the eyes, muzzle and nose. The wool becomes brittle and easily breaks, production decreases and the disease can be complicated by the intervention of bacterial infections [8]. In horses, ringworm is produced by *T. equinum* but also by *T. mentagrophytes* (from rodents, cats or dogs) or *T. verrucosum* (from cattle). It occurs especially in malnourished animals, kept in conditions of poor

hygiene or those constantly subjected to various stressful factors. Live vectors such as rodents and insects can contribute to the transmission of the disease, but harnesses, stable utensils, hay, moisture and crowding also facilitate the spread of the diseases.

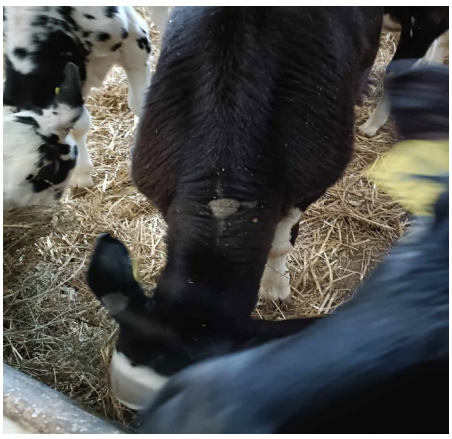

Figure 1. Calf with trichophytic lesions in the neck

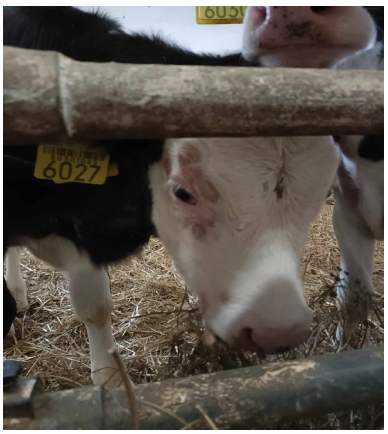

Figure 2. Calf with trichophytic lesions on the face

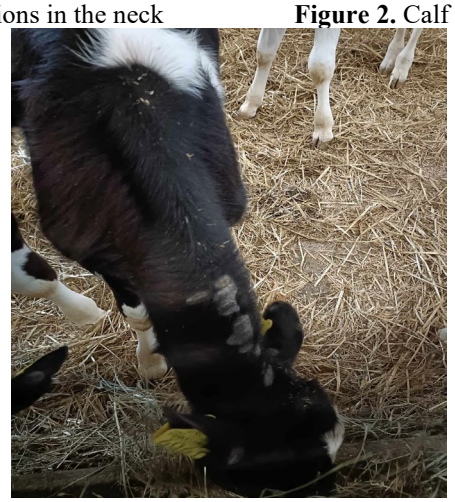

Figure 3. Young bull with extensive trichophytic lesions on the neck

In horses, the lesions appear on the neck, dorsal region, withers, rarely on the head, being very itchy and easily infected due to the fact that the animals rub against various objects causing injuries [9].

In rabbits, trichophytosis is caused by *T. mentagrophytes* and *T. veruccosum*, being found especially in the intensive breeding system of these animals. Primary and secondary sources of infection are also involved in the occurrence and transmission of the disease. The rabbits also develop very itchy lesions and the animals are agitated, ending up mutilating themselves in the areas with trichophytic plaques on the muzzle, around the eyes, ears. Hair falls out and infected lesions can easily cause scurvy in rabbits.

In dogs and cats, trichophytosis is most commonly caused by *T. mentagrophytes* and develops with skin lesions, the areas are covered with crusts, the hair falls out and they can become seriously infected through the intervention of the associated microbial flora [10].

6. Trichophytosis in humans

Trichophytosis in humans is most of the time it appears as an occupational disease, affecting mostly zoo-veterinary staff or it appears in the owners of infected animals [11]. Many species of dermatophytes are zoophiles, it is possible for the disease to be transmitted from animals to humans (especially pets, frequently cats). Usually is located on the skin or its appendages (hair, nails). These fungal infections can lead to a series of clinical manifestations, and depending on the location of this infection, the age of the patient, the mode of manifestation, symptoms and morphological characteristics of the signs of the disease, we have several subtypes of ringworm classified as follows*: tinea capitis* - fungal skin

infection of the scalp, also known as ringworm of the hair or ringworm of the scalp. The disease is mainly caused by dermatophytes of the genus *Trichophyton*, being more common in children. Another form is *tinea corporis*, a superficial fungal infection (dermatophytosis) of the arms and legs but it can appear on any part of the body. It often appears as round red spots. *Tinea cruris* is a type of fungal infection of the groin and anal region that can occur in both sexes, but is more common in men and adolescents. *Tinea unguium* (onychomycosis) - a fungal infection located at the level of the nails, and tinea pedis or athlete's foot - a fungal infection located at the level of the feet. It is frequently seen in people who go barefoot in public places where the infection can spread, such as changing rooms, showers and swimming pools. Majocchi granuloma, also called nodular granulomatous perifolliculitis or granuloma trichophyticum, is a rare infection of the hair follicle caused by dermatophyte fungal infection. Dermatophytes are fungi that invade keratinous tissue such as hair, skin and nails and expand due to a deficient immune system through which the body can no longer fight within the parameters of the spores of these fungi [12]. They usually appear as pink-red papules, pustules or even scaly plaques and nodules in a perifollicular region. The hairs can be easily removed from these infected places, and itching is very common. Majocchi granuloma can involve any hairy surface, but is most often found on the scalp, face, forearms and legs. These areas are susceptible to mechanical damage that causes disruption of the skin barrier. There are two subtypes of Majocchi granuloma, follicular and subcutaneous nodular. The follicular subtype can appear after trauma or the topical use of corticosteroids and can be found in healthy individuals. It most commonly occurs in young women who frequently shave their legs. It is also more widespread in tropical regions. Subcutaneous nodular subtype can appear in immunocompromised populations, such as those under chemotherapy, high doses of corticosteroids or after organ transplantation and diseases such as lymphoma, leukemia, AIDS and others.

9. Conclusions

When trichophytosis appears in farm animals it is important to institute treatment in time, at the first symptoms. In cattle farms, it is best to vaccinate against trichophytosis, both in calves and in adult cows, because individual treatment is difficult and requires a lot of time.

It is very important to maintain proper hygiene and feeding conditions in animal farms and to pay more attention to avoid the introduction of trichophytosis in farms, and if this appears is important to take measures before it spreads in the animal herd [13].

Animal-to-human transmission must be avoided, and when this occurs in farms, people with skin lesions must be urgently referred to human medical offices.

References

1. Dărăbuș, G., Oprescu, I., Morariu, S., Narcisa Mederle, Patologie și boli parazitare, Ed. Mirton, Timișoara, 2006.
2. Pinter, L., Jurak, J., Ukalovic, M., Velmir, S., Epidemiological and clinical features of dermatophytoses in dogs and cats in Croatia between 1990-1998, Vet. Arhiv., 69, 5, 261-270.
3. Cosoroabă, I., Zoonoze parazitare, Ed. First Art-Press, Timișoara, 2005.
4. Cafarchia, C., Gallo, S., Otranto, D., Occurrence and population size of *Malassezia spp*. in external ear canal of dogs and cats both healthy and with otitis, Mycopath., 2005, 160, 2, 143-149.
5. Sparkes, A., Dermatofitoza în Zoonoze, Ed. Șt. Șed., București, 2005.
6. Satalkar, A., Bhikane, A., Bhonsle, A., Ambore, B., Clinical features and treatment of dermatophytosis in cattle, Idian Vet. J., 2006, 83, 2, 212-213.
7. Dărăbuș, G., Oprescu, I., Morariu, S., Radbea, Narcisa, Mate, F., Cercetări terapeutice în tricofiția vițeilor, Scientia Parasitologica, 2004, 1-2, 54-58.
8. Dărăbuș, G., Epidemiologia micozelor și micotoxicozelor în Elemente de epidemiologie a bolilor transmisibile, Ed. Oriz. Univ., Timișoara, 2002.
9. Coman, I., Mareș M., Micologie medicală aplicată, Ed. Junimea, Iași, 2000.
10. Radbea, Narcisa, Dărăbuș, G., Boli micotice, Ed. Aura, 2006.
11. Havlickova, B., Czaika, V. A., Friedrich M. Epidemiological trends in skin mycoses worldwide external icon, Mycoses, 2008.
12. Crissey, J. T., Lang, H., Parish, L. C., Manual of Medical Mycology, Blackwell Science, Cambridge, 1995.
13. Dock, Elly. "Everything You Want to Know About Ringworm."Healthline, 2022, https://www.healthline.com/health/ringworm