mycoses
Diagnosis, Therapy and Prophylaxis of Fungal Diseases

Case report

# An outbreak of *Arthroderma vanbreuseghemii* dermatophytosis at a veterinary school associated with an infected horse

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## Summary

We report a case of an outbreak of inflammatory dermatophytoses caused by *Arthroderma vanbreuseghemii* (formally *Trichophyton mentagrophytes* pro parte) that involved an infected horse, the owner and at least 20 students, staff and stablemen at a veterinary school in Bern (Switzerland) that presented highly inflammatory dermatitis of the body and the face. Transmission from human to human was also recorded as one patient was the partner of an infected person. Both the phenotypic characteristics and ITS sequence of the dermatophytes isolated from the horse and patients were identical, consistent with the conclusion that the fungus originated from the horse. Three infected persons had not been in direct contact with the horse. Although direct transmission from human to human cannot be ruled out, fomites were most likely the source of infection for these three patients. Inspection of the literature at the end of the nineteenth and beginning of the twentieth century revealed that this dermatophyte was frequently transmitted from horses to humans in contact with horses (stablemen, coachmen, carters and artillery soldiers). The rarity of the present case report at the present time is likely related to the transformation of civilisation from the nineteenth century to nowadays in Europe with the change of horse husbandry. In addition, the inadequate immune response of the horse and the high number of people in contact with it at the equine clinic may explain the exceptional aspect of this case report.

**Key words:** Horse, *Arthroderma vanbreuseghemii*, *Trichophyton mentagrophytes*, dermatophytosis, outbreak, epidemiology.

## Introduction

Zoophilic dermatophytoses are among the most common zoonotic diseases and are most often transmitted by direct animal-to-human contact via the fungal elements present on desquamate skin and hair. Today, the majority of zoonotic inflammatory dermatophytoses are contracted from cattle and pet animals, particularly cats, dogs, guinea pigs and rabbits.[1–3] In contrast, dermatophytoses transmitted by horses are uncommon. Most equine dermatophyte infections are indeed caused by *Trichophyton equinum* but this species is rarely isolated from humans where it may cause moderately inflamed lesions.[4,5] Inflammatory dermatomycosis transmitted by a horse can be due to *T. verrucosum*, of which the reservoir is cattle but which occasionally infects horses.[6] We report a case of a horse infected by

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*Arthroderma vanbreuseghemii* (formerly *Trichophyton mentagrophytes* pro parte). This animal was the source of an outbreak of inflammatory dermatophytoses that involved the owner and at least 20 students, staff and stablemen at a veterinary school in Bern (Switzerland). Fungal cultures, when available, underwent molecular characterisation to confirm the relatedness between the human and horse isolates.

## Case report

### Horse

A 2-year-old Arabian stallion was presented during winter at the equine clinic of the Swiss Institute of Equine Medicine (ISME, Vetsuisse Faculty University of Bern), for systemic problems including intermittent fever, chronic nasal and ocular discharge, coughing, unilateral swelling of the maxillary sinus region, enlarged mandibular lymph nodes, recurrent bouts of mild colic and swollen legs. It was presented in the company of another out of the seven horses from the same stable. The stallion was born in Switzerland, and had not travelled abroad like the other horses. A clinical examination revealed multifocal alopecic lesions with mild crusting in both presented horses. Upon further questioning of the owner, it was found that the other five in-contact horses had one or several alopecic lesions as well.

Direct microscopy of hairs revealed dermatophyte-infected hairs and biting lice (*Werneckiella equi*) in both presented horses. After extensive further diagnostic tests, the stallion was diagnosed with bronchitis, a dental eruption cyst and obstruction of the nasolacrimal duct, pediculosis and dermatophytosis. Therapy consisted of oral antibiotic treatment for the bronchitis and obstructed nasolacrimal duct. A single application of a neem tree seed extract solution (Mite Stop®, Felema GmbH, Stäfa) and regular povidone iodine soap washes (Betadine®, Mundipharma Medical Company, Basel, Switzerland) were performed by the owner for treatment of the pediculosis and dermatophytosis respectively. The other six horses in the stable received the same antiparasitic treatment and topical povidone iodine soap washes of alopecic lesions. The owner was informed of the zoonotic potential of dermatophytosis.

Eight weeks later, the stallion was presented again for a recurrence of fever, a poor body condition, multifocal hypotrichosis (Fig. 1) and a generalised crusting dermatitis. Whereas in this horse the skin problems had deteriorated, they had healed in the other six horses, which were clinically normal according to the owner. A diagnosis of dermatophytosis and a secondary pyoderma was made based on direct microscopy, cytology of impression smears and histopathology of skin lesions (Fig. 2).

**Figure 1** Picture of the horse at second presentation and after clipping showing the generalised aspect of the infection.

Hairs were submitted for fungal culture in Sabouraud's agar medium and direct fluorescence microscopy (Fig. 3). After 7 days at 32 °C, the growing fungus showed a white to beige powdery surface attesting for the production of numerous round microconidia (Fig. 4), and was identified as a species belonging to the *Trichophyton mentagrophytes* complex. Fungal genomic DNA was isolated using the DNeasy Plant Mini kit (Qiagen AG, Hombrechtikon, Switzerland) according to the manufacturer's protocol, and part of the 28S ribosomal DNA as well as the internal transcribed spacer (ITS) region of the ribosomal DNA were subsequently amplified by polymerase chain reaction (PCR). A standard PCR protocol with the universal primers LSU1 (5′-GATAGCGM ACAAGTAGAGTG-3′) and LSU2 (5′-GTCCGTGTTTCAAGACGGG-3′) to amplify 28S ribosomal DNA, and LR1 (5′-GGTTGGTTTCTTTTCCT) and SR6R (5′-AAGTAAA AGTCGTAACAAGG) to amplify ITS DNA, was used as described previously.[7–9] The sequences of the PCR products were found to be 100% identical to the sequences AF378740 and AF506034, respectively, which were 100% identical to those of many isolates of *Arthroderma vanbreuseghemii* isolated from humans with inflammatory dermatophytoses as well as hunting cats and dogs.[2]

Because of the systemic problems, the horse was hospitalised and kept in an isolation box and all personnel were instructed to wear gloves and protective clothing. All materials and equipments used for keeping the box clean were kept separately and were later destroyed or sprayed with a surface disinfectant

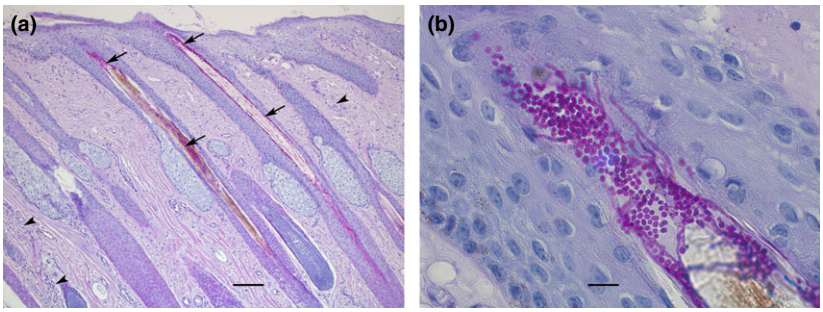


**Figure 2** Histologic sections showing dermatophytes within hair follicles of the skin. (a) Mild epidermal hyperplasia with mild superficial and deep perivascular to interstitial leucocytic infiltrates (arrowhead) and numerous fungal elements within hair shafts and infundibular keratin (arrow) (PAS staining, Bar = 100 μm). (b) Higher magnification of hair follicle presenting with abundant fungal spores and hyphae (PAS staining, Bar = 10 μm).

cleaner with fungicidal properties (Kohrsolin®FF, Hartmann AG, Heidenheim, Germany). At admission, the horse was clipped to remove infected hairs and scales and enilconazole solution was applied properly (Imaverol®, Provet AG, Lyssach, Switzerland) every 5 days. After the horse was clipped, the clippers and the direct environment were thoroughly cleaned and sprayed with the same surface disinfectant cleaner.

Based on the clinical signs and diagnostic test results, a presumed diagnosis of an underlying immune dysfunction was made. The horse was treated for the systemic problems with non-steroidal anti-inflammatory drugs and oral antibiotics for the severe secondary bacterial skin infection. After 6 days, the horse was sent home to continue the antibacterial and antifungal treatment with information on hygiene measurements for horses with dermatophytosis. Two months later, the owner reported that the skin problems had completely resolved. The owner was contacted again later and it was communicated that the horse was euthanised by the private veterinarian 5 months after initial presentation because it was found recumbent in the stable and was unable to stand up. Unfortunately, the horse was not submitted for necropsy.

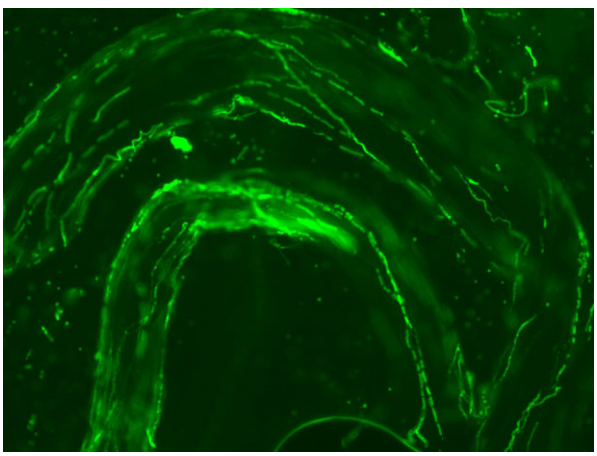

**Figure 3** Dermatophyte-infected hairs of the horse. Direct microscopy was performed in the laboratory using Fluorescent Brightener 28, Sigma F3543 as a fluorochrome as described previously.[26]

## Patients

Twenty-one patients consisting of the owner, students, staff and stablemen were registered as suffering from inflammatory tinea corporis and tinea faciei (Fig. 5). Three people had not been in contact with the horse. One of them had used the common sleeping facility at the clinic. One was a partner of a stableman and one affected student had neither been in contact with the horse nor in close contact with other affected students.

Lesions were often pruritic, single or multiple, annular, sharply marginated and erythemato-squamous, and became vesiculous and sometimes purulent. Dermatomycosis had been confirmed by direct fluorescent mycological examination, which showed a high number of septate filaments and spores (data not shown).

*Arthroderma vanbreuseghemii* was also isolated five times from 11 collected dermatological samples that all were positive by direct mycological examination. Both phenotypic characteristics and ITS sequence were identical to those of the fungus isolated from the horse samples, consistent with the conclusion that the fungus originated from the horse. Depending on the localisation and extent of the lesions, and the physicians or dermatologists involved, topical treatment with various antifungal substances (e.g. clotrimazole, terbinafine and econazole) was successful. At least two patients

received additional oral antifungal therapy consisting of terbinafine and itraconazole, respectively, and fully recovered within 1 month.

## Discussion

We report an outbreak of *Arthroderma vanbreuseghemii* in young adults most of whom had been in contact with an infected horse. Zoophilic dermatophytes apparently lose pathogenicity during serial passage in humans, and thus infections are generally acquired directly from the animal.[10] However, in the present case, one patient was the partner of an infected person and had not even been on the premises of the veterinary school. Although we cannot rule out direct transmission from human to human, we think that

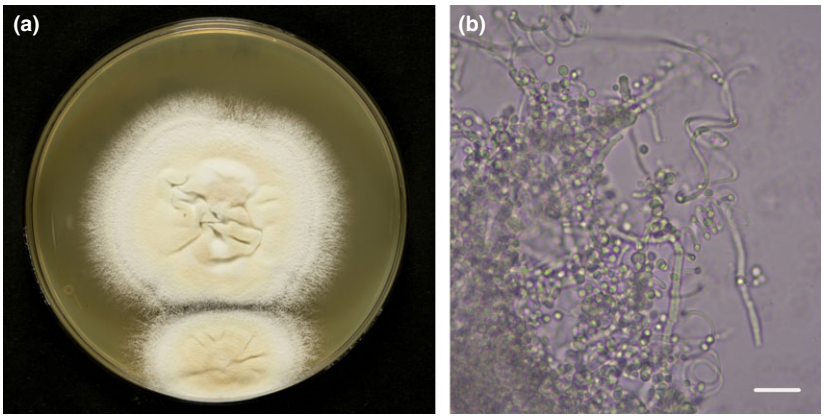


**Figure 4** (a) White powdery aspect of the culture of *Arthroderma vanbreuseghemii* isolated from the horse after 2-week incubation in Sabouraud's agar medium. (b) Microscopic observation of the fungus revealing numerous microspores and spiral hyphae (Bar = 10 μm).


**Figure 5** Inflammatory tinea corporis (a and b) and tinea faciae (c) in students in contact with the horse.

fomites such as clothing or bed linen were most likely the source of infection for all three infected persons that had not been in direct contact with the horse. All people in contact with the horse had to wear a disposable coverall and gloves while the horse was stabled. As it was winter, most people wore warm clothing and possible scarfs underneath these suits which may have functioned as fomites. In spite of strict hygiene measures, it was primarily students who became infected, which may be explained by the fact that students were inexperienced in handling infected animals and in using protective clothing and gloves in a correct way. Moreover, the very severe dermatophytosis in the horse resulted in a very high amount of infectious material and the highly contagious character of *A. vanbreuseghemii* may have contributed to the high number of infected people.[2]

It has been described that ectoparasites such as lice, fleas or *Cheyletiella* mites may transmit dermatophytes.[11] We cannot exclude that *Werneckiella equi* may have been involved in dermatophyte transmission between the other in-contact horses although the localisation of some of the dermatophytic lesions did not match the typical distribution pattern of biting lice. Noteworthy, the disease did not spread to other hospitalised horses or other animals. Whereas the other horses from the same stable fully recovered with only topical treatment, this horse of the present case report suffered from other infections, suggesting an inadequate immune response, which also contributed to its severe dermatophytosis.

*Arthroderma vanbreuseghemii* was previously called *T. mentagrophytes*, like many species that produce numerous pyriform or round microconidia and for which identifications are often difficult to ascertain. Mating experiments and ribosomal DNA sequencing showed that this complex contains different teleomorph species, including *A. benhamiae* and *A. vanbreuseghemii*, and other species for which only the anamorph is known.[8,12,13] *Arthroderma benhamiae* was first described by Ajello and Cheng (1967) after mating strains isolated from rodents,[12] and *A. vanbreuseghemii* was described 6 years later by Takashio after mating strains that were isolated from humans, mice and chinchillas.[13] The name *T. mentagrophytes* is still routinely used in clinical laboratories and in many publications for these two species. However, according to the rules proposed by the Amsterdam declaration on Fungal Nomenclature (One Fungus = One Name),[14] the sexual names *A. benhamiae* and *A. vanbreuseghemii* should be used for these two distinct species.

At present, *A. vanbreuseghemii* is frequently isolated from humans, in particular children and young adults. Most often described or recorded under *Trichophyton mentagrophytes*, this species has a worldwide geographical distribution.[15,16] *Arthroderma vanbreuseghemii* causes highly inflammatory tinea corporis, tinea faciae and tinea capitis in humans similar to *A. benhamiae* and *Trichophyton verrucosum*, of which the main reservoir is the guinea pig and cattle respectively.[3,17] Infections with *A. vanbreuseghemii* are generally contracted from cats and infected dogs where this fungus is often the cause of moderate to severe dermatophytoses.[2,18] Cats with dermatophytosis caused by *A. vanbreuseghemii* are outdoor animals and it is likely that the feline infections with *A. vanbreuseghemii* occur from soil and/or rodent preys. It is important to note that the phenotypic, macroscopic and microscopic characters as well as the 28S and ITS sequences of the fungus isolated from the horse and patients of this outbreak were identical to the *A. vanbreuseghemii* strains usually isolated from cats and dogs and from patients in contact with these animals.[2]

To our knowledge, *A. vanbreuseghemii* infecting a horse is rare. We performed a Pubmed search on September 21st 2014 from which 25 papers came out using the terms 'Horse' and '*Trichophyton mentagrophytes*'. No papers came out using the terms 'Horse' and '*Arthroderma vanbreuseghemii*'. *Trichophyton mentagrophytes* was described and identified by DNA sequencing as the aetiological agent of horse ringworm in Korea[19] was reported in two epidemiological surveys in Norway,[20,21] and was identified as the cause of kerions in horses.[15] In addition, *T. mentagrophytes* was isolated from hooves.[22,23] However, inspection of the literature at the end of the nineteenth and beginning of the twentieth century revealed that *T. mentagrophytes* was frequently transmitted from horses to humans. When Blanchard, in 1896, transferred *Microsporon mentagrophytes* to the genus *Trichophyton*, the fungus was described as similar to that of the present case report with an 'extreme vitality' in culture, and a mycelium 'covered by a white dust made by conidia'.[24] Blanchard reported that 13 of 19 cases observed by Sabouraud were isolated from men in continuous contact with horses (stablemen, coachmen, carters and artillery soldiers). Fifteen years later, Sabouraud reported an outbreak of a dermatophyte, called *Trichophyton granulosum*, similar to *A. vanbreuseghemii*, on 800 horses in Sedan (France).[25] The rarity of the present case report at the present time is likely related to the transformation of civilisation from the nineteenth century to the present day in Europe with the

change of horse husbandry. Nowadays, many horses are kept for sports or leisure activities, live in smaller groups and live under better hygienic conditions with less exchange of tack and blankets which can act as fomites. In addition, the inadequate immune response of the horse and the high number of people in contact with it at the equine clinic may explain the generation of an outbreak.

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