Current Fungal Infection Reports (2019) 13:191–195
https://doi.org/10.1007/s12281-019-00353-7

FUNGAL INFECTIONS OF SKIN AND SUBCUTANEOUS TISSUE (A BONIFAZ AND M PEREIRA, SECTION EDITORS)

Tinea Gladiatorum: an Update

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Published online: 16 November 2019

Abstract

Purpose of Review This article summarizes the main epidemiological characteristics of tinea gladiatorum, new outbreaks that have been presented over the years, and theories about their transmission, diagnosis, treatment, and prophylactic measures.

Recent Findings Despite the controversy, recent studies defined that the transmission of tinea gladiatorum is by skin-to-skin contact and through fomites. Once the infection is acquired, it is difficult to control due to its rapid dissemination to other wrestlers, so great importance has been taken to prevention.

Summary Despite dermatophytosis still being considered as one of the major public health problems in wrestlers, very little attention has been paid by the medical community. In the literature, the majority are reports of outbreaks, so the challenge would be to conduct a more conclusive study that allows us to have a broader picture of this condition.

Keywords Tinea gladiatorum · Wrestlers · Trichophytosis · Dermatophytes

Introduction

Many cutaneous conditions have been reported in wrestlers. Infection with herpes simplex is the most common condition associated and is known as herpes gladiatorum. Greater attention has been paid to the treatment and prevention of herpes gladiatorum because of its serious consequences [1, 2]. Although the presence of tinea corporis in wrestlers has been infrequently reported, most sports medicine authorities believe that is a much more prevalent problem [1]. This condition has several names including tinea corporis gladiatorum, trichophytosis gladiatorum, and tinea gladiatorum; the latter is probably the designation that is more descriptive and informative [3•, 4, 5].

Tinea corporis, itself, is an infection of glabrous skin of the trunk and extremities and is caused by fungal organisms called dermatophytes. The dermatophytes can be categorized into different genera: *Microsporum*, *Trichophyton*, *Nannizzia*, and *Epidermophyton*. Outbreaks of tinea gladiatorum are frequently associated especially with the *Trichophyton* species [6••].

Epidemiology

There are very few reports regarding tinea gladiatorum infection, although there are some reports of outbreaks [3•].

One of the first studies made in Sweden in 1966 examined young male wrestlers who presented to a Stockholm hospital with lesions suspected of being tinea corporis and found approximately 75% had such infection [7].

In 2002, Adams reported an increase in the prevalence of dermatophyte infections in American wrestlers. The study determined the prevalence of tinea gladiatorum in high school wrestlers compared with high school indoor trackers. High school wrestlers revealed a tinea corporis prevalence of 24%, while no members of the track team had evidence of tinea [3•].

An outbreak among wrestlers in Lanzarote, Canary Islands, in 1999, has also been reported with a prevalence of 44.1%, probably the largest reported series of patients [8].

Wrestling is known to be an ancient national sport in Iran. An investigation made by Aghamirian et al. in 2009 examined 270 patients reporting a prevalence of 19.2%, close to what

This article is part of the Topical Collection on *Fungal Infections of Skin and Subcutaneous Tissue*

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Adams stated, that is, the frequency in American wrestling teams [9••] which is also in contrast to Spanish studies (44.1%).

A study conducted in a high school wrestling team in Alaska, determined that it was a public health issue since 75% of wrestlers had tinea corporis [10].

Etiology

Typically, tinea corporis has been caused predominantly by *Trichophyton rubrum*, *Trichophyton mentagrophytes*, and *Microsporum canis*, but in wrestlers, the literature shows a different picture. Most reported cases of tinea corporis gladiatorum have been caused especially by *Trichophyton tonsurans*, which has recently been isolated in > 90% of cases during a 2-year analysis in Iran and is the most isolated microorganism in most outbreaks [11–13].

One possible explanation to this is that this microorganism is present on the scalp of the wrestlers [1, 6••]. *T. tonsurans* has been found in both children and adults during outbreaks, so a carrier state that goes unrecognized has the potential to perpetuate outbreaks in competitors [1, 6••, 7]. This dermatophyte can be integrated to both the human's skin, which can be considered as part of the microbiota and are considered as asymptomatic carriers [6••, 11].

The above differs somewhat from what has been isolated in the groin and body, where *T. rubrum* accounts 32–60% and *T. tonsurans* 17.7–34.3% [14, 15].

Transmission

The epidemiology indicates that the transmission is person-to-person. *T. tonsurans* is an anthropophilic dermatophyte so the theory that skin-to-skin contact is the most likely mode of transmission. There has been some controversy regarding the evidence that suggest dermatophytes can be found in inanimate objects, including hairbrushes, pillow cases, and mats. The environment among the wrestlers is considered to encourage the fomites to act as a possible source of dermatophytes, which results in the perpetuation of an outbreak once a tinea infection has been diagnosed. Kohl et al. conducted a study on wrestling mats taken at the schools and concluded that wrestling mats are very unlikely to be a source of dermatophytosis and believe that lack of growth in the laboratory adds evidence to conclude that dermatophytes are unlikely to persist in wrestling mats in sufficient quantity or with sufficient duration to cause a clinical infection [9••, 16].

However, Aghamirian et al. described that *T. tonsurans* has more affinity to adhere to plastic mats, especially the dyed parts, which causes this microorganism to persist in quantity and for adequate duration. An earlier study showed that *T. tonsurans* can remain viable for a long time in an artificial background [9••, 17].

It seems that the contamination during competition and practice of wrestling mats is an important factor that cause tinea gladiatorum, specifically in head and trunk [6••]. This is because wrestlers spend much time during practice and competition in the "lock-up" position. The head of the competitors is adjacent to each other, so that the cheeks are in constant contact, and their heads contact each other's shoulders and necks, making these areas more susceptible to infections. Headgear has also proven to be a potential source of infection, if shared with other partners [4, 6••].

Vigorous physical exercises in wrestlers cause greater perspiration and therefore make them vulnerable to dermatophyte infections. The tight clothing competitors wear also provides the right environment for the growth of dermatophytes. Likewise, wrestlers might use saunas that increase moisture and make them vulnerable to acquiring tinea [9••].

Clinical Features

Clinically, tinea gladiatorum presents as well defined, erythematous, scaling papules, plaques, and central clearing, located on the head, neck, and upper extremities, areas of contact during wrestling. Symptoms like itching, redness, burning, and scaling may appear. However, the wrestlers may be asymptomatic at the time of presentation [6••].

On the other end of the spectrum, there are inflammatory reactions called kerions, which clinically present large pustular lesions; this often happens when the responsible agent is a zoophilic organism [6••, 18]. A past history of tinea infections makes the individual more likely to acquire it again [14, 19].

Personal hygiene practices and prevention strategies may provide clues, although no risk factors have been described in this particular population [14]. Many infected individuals can remain contagious for months, and it may help to cover their injuries with bandages while practicing [14, 20].

The clinical differential should include nummular eczema, pityriasis rosea, granuloma annulare, psoriasis, seborrheic dermatitis, and subacute cutaneous lupus erythematosus.

Diagnosis

Potassium hydroxide (KOH) preparations are often needed to confirm the diagnosis of tinea infections because of the broad differential diagnosis of tinea corporis. KOH consists in obtaining a sample of the scale by scraping on the edge of the lesion, adding 10 or 20% KOH and placing it under a microscope. The presence of hyphae will appear as long, translucent, branching filaments of uniform width [19]. This technique is simple and cheap; however, the sensitivity of

microscopy is not high (88%), and there is a specificity of 95% (recommendation D, level of evidence 3) [21, 22].

If there is uncertainty and therapeutic failures or for research reasons, it may be necessary to perform fungal cultures to aid in the definitive diagnosis. The recommendation is that all specimens should be cultured on Sabouraud dextrose agar with at least one agar plate containing cycloheximide to inhibit non-dermatophyte mold growth which are contaminants. A positive culture is indicated by growth on the media with a characteristic color change to red, indicating alkalinization of the media. Therefore, any positive screenings on Sabouraud dextrose agar should be sub-cultured onto specific agar, and microscopic examination for morphology should be done; any dermatophyte growing should be identified and reported (recommendation D; level of evidence 4) [21]. *T. tonsurans* micromorphology presents thin hyphae, with abundant pyriform microconidia that are born from the hypha. The drawback with the fugal cultures is that dermatophytes are very slow-growing, and it can take up to 2 weeks for the culture to become positive (Fig. 1).

Treatment

Non-pharmacologic Measures

Wrestlers should be encouraged to shower after training and frequent change of clothes in the competitions. They should also be encouraged to wear loose-fitting garments made of cotton or synthetic materials designed to wick moisture away from the surface.

Because dermatophytes have been isolated from the gym equipment, it is suggested to periodically disinfect the equipment and training areas [1].

Topical Antifungals

Multiple topical antifungals are available to treat tinea corporis. If the infection is widespread, it is useful to apply it as an adjunct to oral antifungals. A meta-analysis conducted by Rotta et al. evaluated the efficacy, involving 14 different treatments and including 65 randomized controlled trials, comparing topical antifungal with one another or with placebo. They found no statistically significant difference between the antifungals concerning the outcome of mycologic cure at the end of the treatment. As a curative treatment, butenafine and terbinafine were superior to clotrimazole, oxiconazole, and sertaconazole; terbinafine to ciclopirox; and naftifine to oxiconazole [23].

Similarly, a Cochrane review on the topical antifungal treatments suggests that individual treatments with terbinafine and naftifine are effective with few adverse effects. Other topical antifungals like azoles are also effective in terms of clinical and mycological cure rates. Topical antifungals are usually given once or twice daily for 2–4 weeks [23, 24].

Luliconazole is a new topical antifungal with fungicidal action against *Trichophyton* species similar to terbinafine. It is available in 1% cream formulation; it is effective once daily

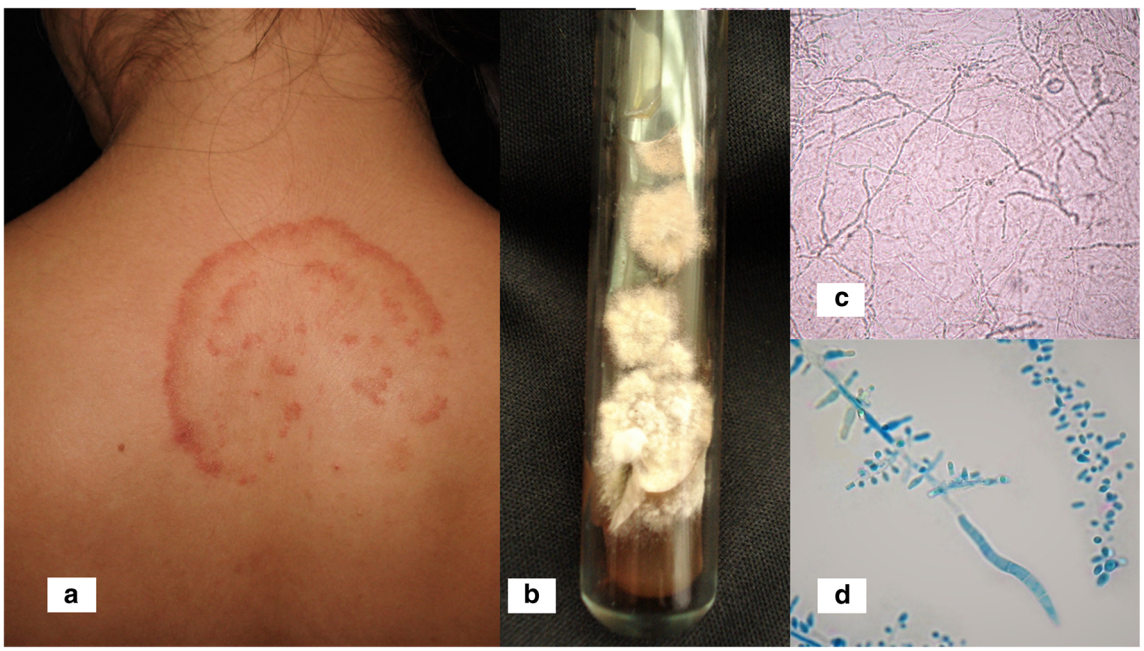

Fig. 1. **a** Tinea gladiatorum in a wrestling student. **b** *T. tonsurans* culture. **c** Multiple hyphae on direct examination (KOH, × 40). *T. tonsurans* microconidia

Table 1 Regimens [29]

Terbinafine	62.5 mg/day (3–5 years), 125 mg/day (6–10 years), 250 mg/day (> 10 years)	1–2 weeks
Itraconazole	100–200 mg/day	1–2 weeks
Fluconazole	150–200 mg once weekly	2–4 weeks
Griseofulvin micronized	500–1000 mg/day	2–4 weeks

application for 1–2 weeks for dermatophytic infection, approved by the US Food and Drug Administration for tinea corporis, with safety profile [23, 25, 26].

Lipid-based amphotericin B gel has had pharmacological characteristics and encouraging clinical results in the treatment of various mucocutaneous fungal infections, including dermatophytosis, with no adverse effect [27].

Amphotericin B in microemulsion presentation shows a 100% increase in skin permanence with better in vitro antifungal activity against *T. rubrum* [28]. In addition, the novel formulation of terbinafine known as terbinafine film forming solution forms a thin film forming topical application and its fungicidal effect remains about 13 days following a single application [23, 28, 30–34].

Oral antifungals

Systemic antifungals are indicated in case of extensive involvement or lack of response to topical treatment. Terbinafine and itraconazole are most commonly prescribed; griseofulvin and fluconazole are also effective but require long-term treatment (Table 1).

Prophylaxis

Pharmacologic prophylaxis for herpes gladiatorum with acyclovir, famciclovir, and valacyclovir has been suggested. Prophylaxis for tinea gladiatorum may be helpful to prevent acquire the infection as well.

Kohl et al. performed a double-blind placebo-controlled trial during 1998 to 1999 on wrestlers who received 100 mg of fluconazole once weekly. Results reported that the use of fluconazole as a prophylaxis significantly reduced the incidence of tinea corporis infections [30]. They mentioned that, in fact, wrestlers not preventively treated with fluconazole were > 6 times more likely to contract an infection, so fluconazole does reduce the occurrence of tinea gladiatorum.

A study performed by Hazen and Weil in a wrestling team who were treated with itraconazole 200 mg twice a day once every 2 weeks for 2 months did not acquire an infection. However, there were many methodological omissions in this study including a sample size of only 37 participants [30, 31].

The use of antifungal talcum powders, which have the function of drying and with an activity against dermatophytes, can be an adequate prophylactic measure. The mostly used treatments are clotrimazole, ketoconazole, and terbinafine

Conclusions

Tinea corporis in wrestlers is a common problem that has not gotten a lot of attention by the medical community. The effects of ringworm infections, including missed practice and matches, have an impact in the team and individual. Disqualifying wrestlers infected with tinea gladiatorum seems unreasonable to some authors, while for others, it is an important preventing measure.

The sports medicine community should look deeper at the individual wrestlers to search for risk factors, protecting factors and potential carriers.

The common sense prevention techniques such as mat cleaning, showering, laundering practice clothing, and educational programs should be studied as comprehensive prevention programs in a diverse population of wrestlers.

Compliance with Ethical Standards

Conflict of Interest Mariana Saldaña and Alexandro Bonifaz declare no conflicts of interest relevant to this manuscript.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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