

Changes in the Clinical and Epidemiological Characteristics of *Trichophyton verrucosum* Infection

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Background: *Trichophyton verrucosum* (*T. verrucosum*) is a zoophilic dermatophyte that causes ringworm in cattle and is prevalent worldwide. This dermatophyte may be responsible for various conditions, especially inflammatory skin lesions.

Objective: In this study, we aimed to investigate the changes in the clinical and epidemiological characteristics of *T. verrucosum* infections in southeastern Korea.

Methods: A total of 34 patients who visited the Catholic Skin Clinic and the Kyungpook National University Hospital in Daegu, Korea from 2005 to 2017 were diagnosed with *T. verrucosum* infection. The diagnosis was confirmed using fungal culture. The data were based on a retrospective survey of the medical records.

Results: The annual incidence of *T. verrucosum* infection was very low. There was no difference in the sexual incidence. *T. verrucosum* infection was most common among subjects in their fifties and sixties. The highest incidence was during the month of September. The arm was most frequently involved, followed by the face. This infection was predominant in patients living in rural areas.

Conclusion: These clinicoepidemiological findings provide useful information for understanding the changes in the infection caused by *T. verrucosum*. In particular, it was interesting to note that the incidence was very low, majority of the affected subjects were in their fifties and sixties, and the most commonly affected site was the arm.

Key Words: Epidemiology, *Trichophyton verrucosum*

INTRODUCTION

Dermatophytosis is a common infection observed worldwide and is believed to affect more than 20–25% of the global population¹. In the last 80 years, considerable changes have been observed in dermatophytosis in Korea, including

changes in the common causative agents of dermatophytosis and its clinical characteristics. The epidemiology of a dermatophyte infection is influenced by the changing patterns of migration, growth in tourism, host immune competence, pathogenicity of the infectious agent, availability of medical treatment, and changes in the socioeconomic conditions^{2–8}.

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Table 1. Annual incidence of *T. verrucosum* infection

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
No. of patients	0	0	0	3	2	1	4	8	6	4	0	3	3

Zoonotic diseases can be transmitted between animals and from animals to humans, causing outbreaks among exposed individuals⁹.

Trichophyton verrucosum (*T. verrucosum*) is a zoophilic fungus known as the primary dermatophyte causing ringworm among cattle in Europe, North America, and other countries. Humans are typically infected via direct contact with the infected cattle, contaminated fomites, or soil; *T. verrucosum* infection is observed worldwide¹⁰. Kerion celsi caused by *T. verrucosum* was first reported in the southwestern province of Korea in 1986 by Kim et al.¹¹. Thereafter, several patients have been infected with *T. verrucosum* in the Young-nam province¹²⁻¹⁵. However, recently, the incidence of *T. verrucosum* infection has been decreasing.

In the present study, we investigated the changes in the epidemiology of *T. verrucosum* through a retrospective analysis of patient medical records from 2005 to 2017 and compared the data with our previous report on the data from 1986 to 2004.

MATERIALS AND METHODS

1. Patients

We performed a retrospective analysis of the medical records of patients who visited the Catholic Skin Clinic and Kyungpook National University Hospital in Daegu from 2005 to 2017. The clinical and epidemiological characteristics of 34 patients infected with *T. verrucosum* were studied. Furthermore, the medical records were compared with those of 196 patients with *T. verrucosum* infection between 1986 and 2004. *T* test was used for the statistical analyses. $p < 0.05$ was considered to be statistically significant.

2. Methods

Total 34 patients with *T. verrucosum* were retrospectively reviewed to determine the annual incidence of the infection and its distribution as per age, sex, season, infection site, and place of residence. The diagnosis of *T. verrucosum* infection was confirmed with macroscopic and microscopic morpho-

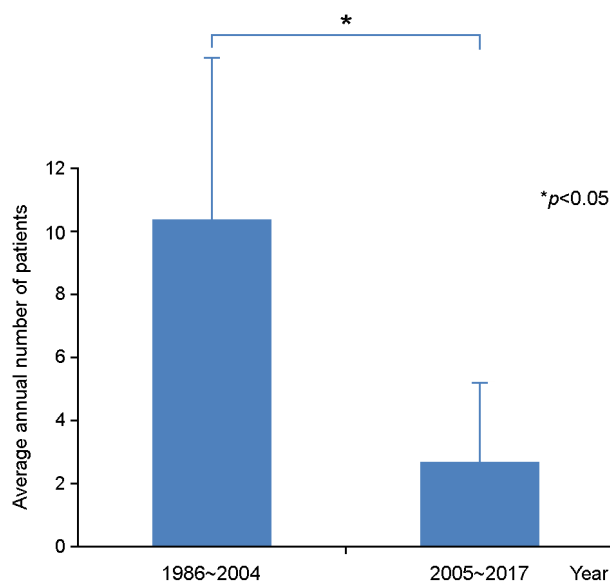


Fig. 1. Average annual number of patients with *T. verrucosum* infection from 1986~2004 and 2005~2017 (*T* test was used for the statistical analyses)

logical examinations of the cultured colonies. Samples of the fungal examination were obtained by scraping the lesions with a scalpel and culturing them using potato dextrose agar-corn meal Tween 80 media. The cultures were kept at 24~26°C and examined after 2~4 weeks.

RESULTS

1. Annual incidence

Total 34 patients were diagnosed with *T. verrucosum* infection (0.00041% among the whole dermatophytosis), and the annual incidence ranged from 0~8 (Table 1). The prevalence of *T. verrucosum* infection was significantly lower than that in our previous study ($p < 0.05$), with a decrease in the annual incidence from 10.3 to 2.6 (Fig. 1). Although the incidence of *T. verrucosum* infection was very low, cases are still observed in Korea.

Table 2. Distribution of patients with *T. verrucosum* infection according to age and sex

Age (y)	Male (%)	Female (%)	Total (%)
< 10	4 (11.8)	2 (5.9)	6 (17.7)
10~19	3 (8.8)	2 (5.9)	5 (14.7)
20~29	0 (0.0)	1 (2.9)	1 (2.9)
30~39	3 (8.8)	1 (2.9)	4 (11.8)
40~49	1 (2.9)	2 (5.9)	3 (8.8)
50~59	1 (2.9)	6 (17.6)	7 (20.6)
60~69	4 (11.8)	3 (8.8)	7 (20.6)
70~79	1 (2.9)	0 (0.0)	1 (2.9)
80~89	0 (0.0)	0 (0.0)	0 (0)
≥ 90	0 (0.0)	0 (0.0)	0 (0)
Total (%)	17 (50.0)	17 (50.0)	34 (100.0)

2. Age- and sex-based distribution

Of the 34 patients, 17 were men and 17 were women (sex ratio of 1:1) (Table 2). Among them, 14 patients (41.2%) were aged 50~69 years. Of the remaining patients, 6 (17.7%) patients were < 10 years old (Table 2). Our previous study showed that 41.3% of all the patients with *T. verrucosum* infection were aged < 15 years.

3. Month and season-based distribution

Total 5 patients (14.7%) visited our hospital for the first time in September. Of the 34 patients, 10 each (29.4%) visited the hospital in spring, fall, or winter, representing the lowest incidence in summer (4, 11.8%) (Table 3).

4. Topographical distribution

The most common site for *T. verrucosum* infection was the arm. Of the 34 patients, 13 (38.2%) had an arm infection (Table 4). The face (9 cases, 26.5%) were the second most common site of infection, while the scalp, back, abdomen, and hip (each 2 cases, each 5.9%) were the third most common sites of infection, followed by the dorsal hand, neck, chest, and leg (each 1 case, each 2.9%) (Table 4). Our previous study reported that the face was the most commonly involved site. Dermatophytosis has several subtypes, depending on the infection site. Tinea corporis was the most common

Table 3. Distribution of patients with *T. verrucosum* infection according to the season and month of infection

Season	Month	No. of patients (%)	Total (%)
Spring	Mar.	2 (5.9)	10 (29.4)
	Apr.	4 (11.8)	
	May.	4 (11.8)	
Summer	Jun.	3 (8.8)	4 (11.8)
	Jul.	0 (0.0)	
	Aug.	1 (2.9)	
Fall	Sep.	5 (14.7)	10 (29.4)
	Oct.	3 (8.8)	
	Nov.	2 (5.9)	
Winter	Dec.	4 (11.8)	10 (29.4)
	Jan.	3 (8.8)	
	Feb.	3 (8.8)	

Table 4. Distribution of patients with *T. verrucosum* infection according to the infection site

Infection site	Number of patients	Proportion (%)
Dorsal hand	1	2.9
Finger web	0	0.0
Toe web	0	0.0
Scalp	2	5.9
Face	9	26.5
Neck	1	2.9
Chest	1	2.9
Back	2	5.9
Abdomen	2	5.9
Arm	13	38.2
Leg	1	2.9
Hip	2	5.9
Total	34	100.0

subtype of dermatophytosis caused by *T. verrucosum*, affecting 22 patients (64.7%) (Table 5). Tinea corporis was defined as dermatophytosis of the neck, chest, back, abdomen, upper

Table 5. Incidence of *T. verrucosum* according to the clinical type

Clinical type	Number of patients	Proportion (%)
Tinea faciei	9	26.5
Tinea capitis	2	5.9
Tinea corporis	22	64.7
Tinea manus	1	2.9
Tinea pedis	0	0.0
Total	34	100.0

and lower extremities, and hip. The second most common subtype was tinea faciei that was observed in 9 patients (26.5%). Tinea capitis was the third most common subtype, affecting 2 patients (5.9%), followed by tinea manus, affecting 1 patient (2.9%) (Table 5).

5. Distribution as per the residential area

Of the 34 patients, 24 (70.6%) lived in rural areas, while 10 lived in urban areas.

DISCUSSION

T. verrucosum was first described by Sabouraud in 1893¹⁶ and was named by Bodin in 1902¹⁷. Folded, heaped, glabrous, and white colonies are observed in the fungal culture. The fungus grows slowly at room temperature, showing distinct chains of chlamydoconidia in the potassium hydroxide test¹⁸. Wood lamp examination shows positive results in infected cattle and negative results in infected humans. In human infections, positive results are observed only at the early stage of the infection¹⁹.

In cattle, *T. verrucosum* infection is often observed on the face, periocular area, and scalp as thick scales and hair loss patches. In humans, the infection presents as diffuse inflammation and confluent erythematous annular plaques with severe discharge and kerion celsi. Although *T. verrucosum* infection is known to be transmitted to humans via contact with infected cattle, there is no definite factor in the infection process that makes it spread¹². In Korea, *T. verrucosum* was isolated from cattle infected with tinea in 1977 and 1978²⁰. In 1986, human infection was first reported in cattle-farming facilities in Jeon-nam area¹¹. From 1962 to 1974, Korea had imported cattle from countries, such as North America. We

believe that *T. verrucosum* strains in Korea may have entered from countries endemic for this infection. The spreading pathway of *T. verrucosum* in Japan may be similar to that in Korea²¹.

Since 1986, the prevalence of *T. verrucosum* infection had been increasing until 2000²². Thereafter, the prevalence has progressively decreased owing to increased awareness regarding the mode of transmission (direct contact with infected cattle) and improved cattle-farming facilities²². This study showed a very low incidence of *T. verrucosum* infection.

As per our knowledge, susceptibility to *T. verrucosum* infection is independent of sex and age. Our study also showed similar results with respect to the sex-based distribution. However, age distribution showed a higher incidence of *T. verrucosum* infection among subjects in their fifties and sixties. Our previous study showed that the highest prevalence of *T. verrucosum* infection was among those aged < 10 years²². Good health care may be a major reason for the reduction in the prevalence of *T. verrucosum* infection among children. Takahashi et al.²³ reported a female to male ratio of 1.3:1. George et al.²⁴ reported that *T. verrucosum* infection was often transmitted within families via contact of contaminated clothes.

The occurrence of *T. verrucosum* infection is reportedly common in winter and spring, that is, from October to June. In this study, 20 patients (58.8%) were infected during winter or spring, that is, from December to May. The seasonal distribution of *T. verrucosum* is different from that of *T. rubrum*. *T. rubrum* infection is most commonly observed during summer²⁵. The incidence of *T. verrucosum* infection correlates with that in cattle. Takahashi et al.²³ reported 40 cases in 41 patients from November to April. Aoyagi et al.²⁶ reported 11 cases from December to March, while Kubo et al.²⁷ reported 47 cases, resulting in a total of 58 cases from December to June.

Kubo et al.²⁷ and George et al.²⁴ reported that *T. verrucosum* infection mainly occurs on the exposed body parts, such as the face, scalp, and upper extremities. Our previous study also reported similar results²². However, we found that the upper extremities were the most common infection site. The higher incidence of *T. verrucosum* infection among those in their fifties and sixties may explain that the upper extremities were more commonly involved than the face.

T. rubrum infection was checked predominantly in urban areas²⁵; however, *T. verrucosum* infection was checked in rural areas, because of the exposure to infected cattle. Treatment for *T. verrucosum* infection includes the administration of oral antifungal agents, such as terbinafine, fluconazole, and griseofulvin, and some topical agents. However, treatment with topical agents alone may require more time and may have lower rates of patient compliance, making it less effective²⁸.

As observed in the present study, the incidence of *T. verrucosum* infection has changed considerably over the previous 40 years. The gradual decrease in the annual incidence of *T. verrucosum* infections was prominent from 2000 to 2017. The common causes of dermatophytosis in Korea have been changing owing to increasing public health education and lifestyle diversity. *T. verrucosum* infection has almost disappeared from Korea; however, there is a possibility of its re-appearance. Therefore, public awareness and continuous observation for this organism and infection are crucial. We believe that this study will help dermatologists obtain advanced information regarding the epidemiologic changes with respect to *T. verrucosum* in Korea.

CONFLICT OF INTEREST

In relation to this article, We declare that there is no conflict of interest.

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