Tinea capitis (TC) is a dermatophytosis of the scalp caused by the *Trichophyton* and *Microsporum* genera. The condition can be classified according to clinical symptoms or based on mycological presentations observed on direct examination. Treatment is best determined after isolation of the causative agent, with griseofulvin indicated for *Microsporum* and terbinafine for *Trichophyton*. Materials and Methods: This was a prospective study correlating clinical and mycological classifications with agents isolated from culture of patients seen at a tertiary hospital in São Paulo (Brazil) between May 15, 2017, and January 11, 2019. Results: A total of 23 patients were treated, comprising 19 (83%) with alopecic clinical aspect (14 [60%] trichophytic and five [23%] microsporic) and 4 (17%) with kerion celsi presentation. According to the parasite invasion at the hair shaft, 9 (40%) were endothrix and 14 (60%) were ectothrix cases. *Trichophyton tonsurans* was isolated from culture in 14 (60%) patients and *Microsporum canis* in 5 (40%) patients. A statistically significant association was found for mycological classification and agent isolated from culture (*P* = 0.003) with associations of the endothrix form with *T. tonsurans* and of ectothrix with *M. canis*. Conclusions: The mycological classification appears to be a valid method for suggesting the etiological agent of TC.

Key words: Diagnosis, mycology, tinea infection

INTRODUCTION

Tinea capitis (TC) is a dermatophytosis of the scalp common in children and rare in adults. The pathogens that cause the condition are members of only two genera: *Trichophyton* and *Microsporum*. Broad epidemiological variation in TC causative agents has been reported globally, partly due to the influences of major population migrations: *Trichophyton tonsurans* is currently the most common fungus strain in the USA and India, whereas *Microsporum canis* is the most frequent agent in Brazil, Turkey, Italy, and Germany.[1-3] TC can be classified according to clinical or mycological presentation observed on direct examination [Figure 1]. The clinical manifestations can be grouped into tonsurant and inflammatory. Tonsurant cases are characterized by patches of alopecia, generally circular and with a variable pustular nature, where hairs have broken off close to the scalp, resulting in an aspect resembling a tonsure – a skullcap cut adopted by monks. These can be subdivided into two patterns: a microsporic pattern, with few lesions which can reach large diameters, and a trichophytic pattern, with multiple and smaller lesions that can become confluent and affect larger areas, hampering their classification.

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Peixoto, et al.: Tinea capitis: Clinical presentation and mycological examinations

Conventionally, tonsurant trichophytic TC are known to be caused by anthropophilic agents of the *Trichophyton* genus and tonsurant microsporic TC by zoophilic or geophilic agents of the *Microsporum* genus. Inflammatory tineas are considered in the literature as being caused by fungi nonadapted to humans, which theoretically induce a more intense inflammatory response, notably zoophilic species. Inflammatory TC can be subdivided into suppurative tinea (or kerion celsi) and favi tinea (or favus). In kerion celsi, the clinical presentation is scaling plaques with an intense local inflammatory process, edema, rubor, and purulent secretion; favus tinea is characterized by inflammatory mass of yellowish concave crusts and a single central shaft. The mycological classifications, observed on direct mycological examination, indicate the pattern of invasion of the hair shaft as: endothrix, with the presence of multiple arthroconidia within the hair shaft; and ectothrix, with the presence of fungal structures (arthroconidia and/or hyphae) within and on the exterior the hair shaft.

Treatment of TC can be carried out using systemic antifungals, with griseofulvin being the most indicated in cases of parasitic infection by fungus of the *Microsporum* genus and terbinafine for the *Trichophyton* genus. The culture for fungus is necessary to determine the causative agent of the infection and thus define the best treatment of choice for each case. Accuracy of dermatophyte identification on the scalp by clinical observation can be improved by analysis using a Wood’s lamp, where cases involving the parasite *M. canis* present greenish-blue fluorescence, light blue for *Trichophyton schoenleinii*, and no fluorescence for *T. tonsurans*. More recent studies have sought correlation between trichoscopic findings and agents isolated from culture in a bid to define the etiologic agent without the need to perform cultures.

We report a study performed in children infected with TC seen at a tertiary hospital in São Paulo city (Southeastern part of Brazil). Clinical and mycological classifications were correlated with the agents isolated from culture to help guide the choice of therapy at the first visit, without having to await results of fungus cultures.

**MATERIALS AND METHODS**

A prospective cross-sectional study was conducted at the superficial mycosis outpatient unit of the dermatology clinic of a tertiary hospital in São Paulo city between May 15, 2017, and January 11, 2019. The research project was submitted and accepted by the Institutional Research Ethics Committee (CAAE No.: 78769317.5.0000.5479).

The study included patients of both genders, any age, presenting with scalp lesions clinically consistent with a diagnosis of TC, whose mycological examination disclosed fungal parasites at the hair shaft, and agents were isolated from culture for fungus, and who agreed to take part in the study by signing the free informed consent form or consent/agreement form in the case of minors. All patients not fulfilling the criteria outlined were excluded.

The results were tabulated and defined as follows: clinical tonsurant or inflammatory aspects, with tonsurant subdivided into trichophytic and microsporic and inflammatory into kerion celsi and favus. Mycological aspects were classified into endothrix, with parasitic spores within the hair shaft and preservation of the hair cuticle; and ectothrix, with the presence of fungal structures (arthroconidia and/or hyphae) within and on the exterior the hair shaft. All statistical analyses were performed using the IBM SPSS Statistics V22.0.0 - Armonk, New York, EU. Fisher’s exact test was employed to determine the presence or otherwise of association among the variables.

**RESULTS**

A total of 25 patients were treated during the study period. Two participants were excluded for not meeting...
the inclusion criteria, giving a final study sample of 23 patients.

The age of patients ranged from 2 to 12 years, mean age was 6.9 ± 3.2, and median age was 7 years. Regarding gender, 20 (87%) patients were male and 3 (13%) female. Concerning clinical form, there were 19 (83%) cases of tonsurant TC and 4 (17%) cases of inflammatory TC. Of the tonsurant forms, 14 (74%) were trichophytic (60% of total) and 5 (26%) microsporic (23% of total). All inflammatory TC cases were caused by kerion celsi and there were no favus forms, a rare clinical presentation in the region studied. Regarding mycological presentation, 9 (40%) were endothrix and 14 (60%) ectothrix. There was no evidence of favus forms on mycological analyses. From the fungal culture of the 23 cases, T. tonsurans was isolated in 14 (60%) and M. canis in 9 (40%) cases. No other fungal species were isolated in the cases studied [Table 1].

Comparison of clinical forms and direct mycological examinations showed that all inflammatory cases (four patients – 100%) involved ectothrix. A more even distribution was found for tonsurant cases, where 10 (53%) patients had ectothrix and 9 (47%) endothrix. Separate assessment of tonsurant cases showed that the microsporic tinea had 80% (four cases) endothrix involvement and 20% (one case) ectothrix, whereas trichophytic cases had 64% (nine cases) ectothrix and 36% (five cases) endothrix [Table 2]. No statistical association was observed among the clinical variables and endo- and ectothrix parasitism (P = 0.127) or between tonsurant forms and parasitism of the fungus on the hair shaft (P = 0.141).

Analysis of the clinical forms correlating with etiological agent revealed that, for inflammatory tineas, 2 (50%) were caused by M. canis and 2 (50%) by T. tonsurans. The tonsurant infections were caused by T. tonsurans in 12 (63%) cases and by M. canis in 7 (37%) cases. In the tonsurant cases, 4 (80%) microsporic tineas were caused by T. tonsurans and 1 (20%) by M. canis; in the trichophytic cases, the agent isolated was T. tonsurans in 8 (57%) cases and M. canis in 6 (43%) [Table 3]. No statistical association was found between the inflammatory and tonsurant clinical forms and fungus cultures (P = 1.000). There was no correlation of the trichophytic and microsporic tonsurant forms with T. tonsurans and M. canis (P = 0.603).

Finally, the results of direct mycological examinations for T. tonsurans and M. canis showed that of the T. tonsurans cases, 9 (64%) involved the endothrix parasite and 5 (36%) ectothrix. All of the M. canis cases (nine – 100%) involved ectothrix infection [Table 4]. Statistical analysis confirmed a statistically significant association (P = 0.003).

**DISCUSSION**

The epidemiological data found are consistent with the scientific literature, with TC affecting children and adolescents with main agents T. tonsurans and M. canis. However, it is important to note that this is the first confirmation of cases caused predominantly

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**Table 1: Clinical and mycological aspects of the studied cases**

| Clinical and mycological characteristics | N° (%) |
|------------------------------------------|--------|
| Gender                                   |        |
| Male                                     | 20 (87)|
| Female                                   | 3 (13)|
| Total                                    | 23 (100)|
| Clinical presentation                    |        |
| Tonsuric (alopecic)                      |        |
| Trichophytic                             | 14 (60)|
| Microsporic                              | 5 (23)|
| Inflammatory                             |        |
| Kerion celsi                             | 4 (17)|
| Total                                    | 23 (100)|
| Fungal culture                           |        |
| Trichophyton tonsurans                   | 14 (60)|
| Microsporum canis                        | 9 (40)|
| Total                                    | 23 (100)|

DME: Direct microscopic examination

**Table 2: Correlation between clinical presentation and hair fungi invasion**

| Clinical presentation | DME | Total |
|-----------------------|-----|-------|
|                       | Endothrix | Ectothrix | |
| Alopecia/tonsuric      | Microsporic | 4 | 1 | 5 |
|                       | Trichophytic | 5 | 9 | 14 |
| Inflammatory          | 0 | 4 | 4 |
| Total                 | 9 | 14 | 23 |

**Table 3: Correlation between clinical forms and agents isolated at culture**

| Clinical presentation | Microsporum canis | Trichophyton tonsurans | Total |
|-----------------------|-------------------|------------------------|-------|
| Alopecia/tonsuric      | 1 | 4 | 5 |
|                       | 6 | 8 | 14 |
| Inflammatory          | 2 | 2 | 4 |
| Total                 | 9 | 14 | 23 |
by *T. tonsurans* as opposed to *M. canis*, in the geographic area of the present study (Southeastern Brazil). This finding may have been due to shifts in the population as a result of migratory processes, climate change, change in behavioral factors regarding pets, or other as yet unknown factors. Changes in the main agents have previously been reported in other regions such as Europe and the USA.[2,9,10]

No statistically significant relationship was found between clinical aspects and etiological agents, mirroring results of a recent study of 57 patients with TC by Veasey and Muzy.[4] These findings break the paradigm that trichophytic tineas are caused by the *Trichophyton* genus and microsporic by the *Microsporum* genus, which gave rise to the original clinical nomenclature. In the current casuistic, 50% of cases of inflammatory tineas were infected by anthropophilic strains. Therefore, mere clinical classification cannot be considered a reliable method for determining etiological agent, in tonsurant tineas or kerion celsi, and the clinical manifestation of TC hinges not only on the type of dermatophyte invading the lesion but also the intensity of the inflammatory response produced by the host to the invasive agent.

The statistical significance between the mycological classification and causative agent of the infection found in the present study is consistent with that reported by Elewski et al.[1] This finding is extremely valuable in medical practice, akin to the Wood’s lamp,[1] because it can help physicians determine the genus of the dermatophyte causing the TC without resorting to fungal cultures and also guide optimal treatment using the most suitable antifungal drug for each case: terbinafine for endothrix (*T. tonsurans*) and griseofulvin for ectothrix (*M. canis*).

This study has some limitations, including the small number of cases assessed, absence of the favus clinical and mycological form, and isolation of only two fungal species, thereby limiting interpretation of results. Future studies involving a wider variety of cases and isolation of other fungal species are warranted to further elucidate the findings reported.

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**Table 4: Correlation between parasite invasion detected by direct mycological examination and agents isolated at culture**

| DME          | *Microsporum canis* | *Trichophyton tonsurans* | Total |
|--------------|---------------------|--------------------------|-------|
| Endothrix    | 0                   | 9                        | 9     |
| Ectothrix    | 9                   | 5                        | 14    |
| Total        | 9                   | 14                       | 23    |

DME: Direct microscopic examination

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**CONCLUSIONS**

The results of this study showed that clinical classification was not correlated with the agents isolated from culture or with the type of hair shaft involvement (endothrix and ectothrix) observed on direct mycological examination. However, analysis by direct microscopy of specimens collected from patients with TC can indicate a greater likelihood of having a given etiological agent; samples containing endothrix hair shafts are more likely to be invaded by *T. tonsurans*, whereas ectothrix hair shafts are more likely to be invaded by *M. canis*.

Finally, despite the availability of different indirect methods, such as Wood’s lamp and findings on direct mycological examinations that can suggest the possible dermatophyte, culture for fungus remains the gold standard for identifying the pathogen causing TC.

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**Conflicts of interest**

There are no conflicts of interest.

**REFERENCES**

1. Elewski BE, Hughey LC, Hunt KM, Hay RJ. Fungal diseases. In: Bolognia JL, Schaffer JV, Cerroni L, editors. Dermatology. Amsterdam: Elsevier; 2018. p. 1329-62.
2. Veasey JV, Miguel BA, Mayor SA, Zaitz C, Muramatu LH, Serrano JA. Epidemiological profile of tinea capitis in São Paulo city. An Bras Dermatol 2017;92:283-4.
3. Gupta AK, Mays RR, Versteeg SG, Piraccini BM, Shear NH, Piguet V, et al. Tinea capitis in children: A systematic review of management. J Eur Acad Dermatol Venereol 2018;32:2264-74.
4. Veasey JV, Muzy GS. Tinea capitis: Correlation of clinical presentations to agents identified in mycological culture. An Bras Dermatol 2018;93:465-6.
5. Veasey JV, Miguel BA, Bedrikow RB. Wood’s lamp in dermatology: Applications in the daily practice. Surg Cosmet Dermatol 2017;9:324-6.
6. Veasey JV, Meneses OMS, da Silva FO. Reflectance confocal microscopy of tinea capitis: Comparing images with results of dermoscopy and mycological exams. Int J Dermatol 2019;58:849-51.
7. Lekkas D, Ioannides D, Apalla Z, Lallas A, Lazaridou E, Sotiriou E. Dermoscopy for discriminating between *Trichophyton* and *Microsporum* infections in tinea capitis. J Eur Acad Dermatol Venereol 2018;32:c234-5.
8. Marques SA, Camargo RM, Fares AH, Takashi RM, Stolf HO. Tinea capitis: epidemiological and ecological aspects of cases observed from 1983 to 2003 in the Botucatu Medical School, state of São Paulo-Brazil. An Bras Dermatol 2005;80:597-602.
9. Binder B, Lackner HK, Poessl BD, Propst E, Weger W, Smolle J, et al. Prevalence of tinea capitis in Southeastern Austria between 1983 and 2008: Up-to-date picture of the current situation. Mycoses 2011;54:243-7.
10. Hay RJ, Robles W, Midgley G, Moore MK, European Confederation of Medical Mycology Working Party on Tinea Capitis. Tinea capitis in Europe: New perspective on an old problem. J Eur Acad Dermatol Venereol 2001;15:229-33.

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