White Piedra: Clinical, Mycological, and Therapeutic Experience of Fourteen Cases

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Keywords

White piedra · Scalp infection · *Trichosporon* sp. · *Trichosporon inkin* · Matrix-assisted laser desorption/ionization time-of-flight mass spectrometry · Topical ketoconazole

Abstract

Background: White piedra (WP) is an asymptomatic superficial mycosis that affects the hair stems, forming whitish nodules caused by various species of the genus *Trichosporon*. **Objective:** To present a case series of WP of the head, its epidemiological data, as well as clinical, mycological, and therapeutic experience. **Methods:** We conducted a 12-year retrospective and observational study of WP cases tested by dermoscopy, mycological study, and the identification of species through morphology, biochemistry, and proteomics (matrix-assisted laser desorption/ionization time-of-flight mass spectrometry). The treatment was based on ketoconazole shampoo as well as keratolytics. **Results:** We included 14 cases of WP, all located in the head and 1 case with

both head and scrotum affected. Nine cases (64.3%) presented in children aged <15 years. The majority of the cases (13/14, 92.8%) were women. Two cases were associated with hyperkeratosis and intertrigo. Most patients had long hair and excessive moisture. In all cases hair nodules were observed and *Trichosporon inkin* (11/14, 78.6%) was usually isolated. Eleven cases (78.6%) were cured by administering 2% ketoconazole shampoo. **Conclusion:** WP was observed in school-age girls. The diagnosis was based on the observation of hair nodules and its main etiologic agent was *T. inkin*, with good response to treatment in most cases.

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Introduction

White piedra (WP) is a superficial mycosis caused by the yeast fungi of the genus *Trichosporon*. It is a rare and asymptomatic infection that affects stem hair in the form of adherent, soft, whitish concretions or nodules, especially in the head and to a lesser extent the beard, mous-

Table 1. Demographic, clinical, mycological, and therapeutic data

Parameters	Data (n = 14)
Age	range: 7–31 years average: 16.25 years children (<15 years): 9 (64.28%) adults: 5 (35.7%)
Sex	female: 13 (92.8%) male: 1 (7.2%)
Occupation	pupils and students: 9 (64.3%) housewives: 3 (21.4%) employed: 1 (7.2%) none: 1 (7.2%)
Clinical topography	head hair only: 13 (92.8%). head hair and scrotal hair: 1 (7.2%)
Symptoms	asymptomatic: 12 (85.7%) pruritus: 2 (14.3%) ^a
Predisposing factors	long hair: 13 (92.9%) curly hair: 9 (64.3%) excess humidity: 8 (57.1%) diabetes mellitus type 2: 2 (14.3%)
Climate/place of provenance	temperate (Mexican metropolitan area): 7 (50%) tropical (Veracruz, Guerrero, Sinaloa, Chiapas): 7 (50%)
Clinical features (dermoscopy)	multiple white nodules (concretions): 14 (100%) ^b
Mycological data	KOH (microscopic nodules or concretions formed by multiple arthroconidia and hyphae): 14 (100%) Etiologic agents: <i>Trichosporon inkin</i> : 11 (78.6%) <i>Trichosporon ovoides</i> : 2 (14.2%) <i>Trichosporon cutaneum</i> : 1 (7.2%) Bacterial culture: <i>Staphylococcus aureus</i> : 2 (14.3%)
Treatment	2% ketoconazole shampoo: 11/14 (78.6%) itraconazole (200 mg/day) + 2% ketoconazole shampoo: 1/14 (7.2%) 1% salicylic acid: 2/12 (14.4%)

^a Cases with hyperkeratosis and intertrigo. ^b One case associated with inguinal intertrigo, another one with nuchal hyperkeratosis.

tache, eyelashes, armpits, and pubis [1–4]. The first case was reported by Beigel in 1865 in Germany through observations in natural wigs. The etiologic agent of WP for many years was recognized as *Trichosporon beigelii* [2], but with the development of studies of molecular biology, Guého et al. [5] reordered the genus and classified sev-

eral species; at present, approximately 50 species have been recognized and divided into four clades, of which 16 species are considered pathogenic for humans. The main etiologic agents of WP are *Trichosporon inkin*, *Trichosporon ovoides*, *Trichosporon cutaneum*, and exceptionally *Trichosporon asahii* and *Trichosporon loubieri* [2, 6]. WP is a cosmopolitan condition, but it is most commonly present in humid and tropical climates, although there are reports in colder regions. It has a marked prevalence in women and in subjects aged <15 years [4, 6, 7].

We present a case series of WP, describing the epidemiological characteristics as well as clinical, mycological, and therapeutic experience.

Patients and Methods

A retrospective study of WP cases was carried out; the patients were seen in our dermatology department from January 2006 to December 2017 (12 years). In all cases the clinical diagnosis was made by Wood's light. Also, hairs were taken, and in cases with superficial skin condition, scales were taken. In both samples, KOH (10%) direct examination and KOH + blue cotton were performed; in some parasitized hairs scanning electron microscopy (JEOL[®] microscope, Model JSM-5300) was performed. Sabouraud dextrose-agar media, with and without antibiotics, were used for culture. The cultures were confirmed by the type of reproduction and by two methods: assimilation of carbohydrates by a commercial system (VITEK[®] 2 YST ID card) and by proteomic identification with matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS), type Vitek-MS[®], with short extraction in plaque (formic acid at 25% and acid α -cyan-4-hydroxycinnamic) and identifications with high concordance value (>98%) were determined [8]. The treatment included 2% ketoconazole shampoo for 1–2 months, and in cases of partial or null response, 1% salicylic acid preparations with or without oral itraconazole were used.

Results

During the 12-year period, 14 cases of WP were recorded; the demographic, clinical, mycological, and therapeutic data are presented in Tables 1 and 2.

Of the cases included, 14 corresponded to WP of the head and 1 also presented WP in the scrotum. One patient presented hyperkeratosis in the nape of the neck, and in the patient with the scrotal affection an intertriginous plaque with erythema was observed (Fig. 1). Both hyphae and arthroconidia were observed, and the same etiologic agent was isolated and identified (Fig. 2, 3). The identification was based on three methods (morphological, biochemical, and proteomic) and is presented in Table 3.

Table 2. List of included cases of white piedra

Case No.	Age, years	Sex	Occupation	Clinical topography	Symptoms	Predisposing factors	Clinical features	Etiology	Treatment
1	13	F	pupil	head hair	asymptomatic	long curly hair	nodules	<i>T. ovoides</i>	ketoconazole shampoo
2	7	F	pupil	head hair	asymptomatic	long curly hair	nodules	<i>T. inkin</i>	ketoconazole shampoo
3	9	F	pupil	head hair	asymptomatic	long curly hair	nodules	<i>T. inkin</i>	ketoconazole shampoo
4	30	F	housewife	head hair	asymptomatic	long hair	nodules	<i>T. inkin</i>	salicylic acid
5	14	F	student	head hair	asymptomatic	long curly hair	nodules	<i>T. inkin</i>	ketoconazole shampoo
6	6	F	pupil	head hair	asymptomatic	long curly hair	nodules	<i>T. inkin</i>	ketoconazole shampoo
7	29	M	employed	head and scrotal hair	pruritus	type 2 diabetes mellitus	nodules	<i>T. cutaneum</i>	ketoconazole shampoo
8	8	F	pupil	head hair	asymptomatic	long hair	nodules	<i>T. inkin</i>	ketoconazole shampoo
9	29	F	housewife	head hair, hyperkeratosis	pruritus	long curly hair	nodules	<i>T. inkin</i>	ketoconazole shampoo and itraconazole
10	9	F	pupil	head hair	asymptomatic	long hair	nodules	<i>T. inkin</i>	ketoconazole shampoo
11	7	F	pupil	head hair	asymptomatic	long hair	nodules	<i>T. inkin</i>	ketoconazole shampoo
12	31	F	housewife	head hair	asymptomatic	long curly hair	nodules	<i>T. inkin</i>	ketoconazole shampoo
13	25	F	student	head hair	asymptomatic	long curly hair	nodules	<i>T. ovoides</i>	salicylic acid
14	10	F	pupil	head hair	asymptomatic	long curly hair, type 2 diabetes mellitus	nodules, intertrigo	<i>T. inkin</i>	ketoconazole shampoo

Table 3. Identification of the etiologic agents of white piedra

Etiologic agent (morphology)	VITEK [®] 2YST ID card (n = 14)	MALDI-TOF MS (Vitek-MS [®]) (n = 14)
<i>Trichosporon</i> sp.	<i>T. inkin</i> : 9 (64.2%) <i>T. cutaneum</i> : 1 (7.2%) <i>Trichosporon</i> sp.: 2 (14.3%) not identified: 2 (14.3%)	<i>T. inkin</i> : 11 (78.5%) <i>T. ovoides</i> : 2 (14.3%) <i>T. cutaneum</i> : 1 (7.2%)
Species identified	12 (85.7%)	14 (100%)
MALDI-TOF MS, matrix-assisted laser desorption/ionization time-of-flight mass spectrometry.		

Discussion

WP is a rare, worldwide mycosis, although most cases are located in tropical and humid regions. Ramírez-Soto et al. [9], in a recent systematic review of cases in the Americas, reported 106 cases of WP, with a predomi-

nance of 73.58% for South America, the most endemic countries being Brazil, Colombia, and Venezuela, while in North America, Mexico and the US reported the highest number of cases. In our case series, at least 50% of the cases came from humid and tropical areas.

Fig. 1. **a** Overview of a white piedra. **b** Dermoscopy: irregular white nodules. **c** Closer view of the nodules with dermoscopy.

Fig. 2. **a** Direct examination of a white stone nodule (KOH + blue cotton, $\times 40$). **b** Nodule under electron microscopy (scale bar, 100 μm [$\times 75$]). **c** Conformation of hyphae mass and arthroconidia and blastoconidia (scale bar, 100 μm [$\times 150$]).

WP can present at all ages, although there is a prevalence of up to 89% in subjects <15 years and most often in girls [4, 6, 9–12], similar to our findings. The development of the disease remains unknown, although it is known that the various species of *Trichosporon* that cause WP have been reported as part of the microbiota of skin

and mucous membranes. It is possible that under certain conditions of humidity of the hair, a mass of microorganisms that adhere to the stem is formed and kept together by adhesive substances, similar to what happens with biofilms [2, 6]. Some authors report that the development of the disease depends on poor hygiene, but this has not

Fig. 3. a *Trichosporon inkin* colony in Sabouraud medium which developed from different parts of the hair. **b** Arthroconidia and blastoconidia of *T. inkin* (blue cotton, $\times 100$).

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been demonstrated, although long and compact hair, as well as the use of bands on the hair, are factors that arise in the majority of cases [1, 4, 7], similar to what was observed in our study.

WP presents as compact, irregular hair nodules, strongly adhering to the hair, which measure between 1 and 3 mm; the nodules are white-yellowish, have a soft consistency, and some patients refer to them as if they had “stones or pebbles in the hair” [3, 4, 6]. In electron microscopy studies, a well-organized mass of microorganisms is observed, sometimes with a bacterial coating that probably helps to establish the nodule and that it is mainly constituted by *Corynebacterium* sp. and other constituent microorganisms of the microbiota [4, 13–15]. In our study, an association with *S. aureus* was verified in 2 cases.

With the advent of dermoscopy, the diagnosis of WP has become easier because the whitish nodules that distinguish it from other fungal conditions such as black piedra, caused by the black fungus *Piedraia hortae*, can be clearly observed. It should also be distinguished from pediculosis nits, which may even coexist with WP, and some other hair diseases such as trichomycosis, trichorrhexis nodosa, and pili torti [3, 4, 16–19].

In our study, most of the cases presented in children (64.28%) and the remaining ones in adults. However, 3 out of 5 adult cases corresponded to mothers whose

daughters presented WP simultaneously, making it difficult to establish the origin of the infection. Micro-outbreaks have been reported in nurseries and explain the transmission of the infection [1, 4, 12, 20, 21].

All cases of WP were of the head, and one of these was also associated with scrotal hairs, which is a rare location [4, 22, 23]. In two chronic cases with type 2 diabetes mellitus, superficial cutaneous trichosporonosis was also present, i.e., a superficial infection with development of erythematous, scaly plaques, similar to superficial candidiasis with pruritus, and in both cases the same etiologic agent (*T. inkin*), was isolated. This manifestation is likely to be favored by diabetes, which has been reported from mucocutaneous to systemic infections [4, 24].

The diagnosis is relatively simple through conventional laboratory techniques, such as direct examination with KOH or with various dyes such as blue cotton, observing irregular nodules that envelop the hair stem and are formed by masses of hyphae with arthroconidia and that unlike tinea capitis do not pierce the hair. The nodules are accurately observed with scanning electron microscopy. Cultures are easy to obtain in a short time. All species of *Trichosporon* form pseudohyphae as well as hyphae and are reproduced by arthroconidia and blastoconidia [2, 4, 6].

The genus *Trichosporon* was reordered by Guého et al. [5] since 1994, and now we have more knowledge of the species causing WP. The oldest reports indicate that the

etiologic agent was *T. beigelii*, which is not used anymore and which was replaced by several species [2, 23, 25, 26]. Previous reports indicate that the main etiologic agent is *T. cutaneum*, but its identification is only micromorphological and biochemical, so it is most likely that it is not the right species [1]. Other series indicate that the main agent of WP of the head is *T. ovoides* and that *T. inkin* predominates in inguinal and scrotal hair [2, 4, 6, 27]. However, in recent reports it is mentioned that in most of the cases identified by molecular biology or proteomics, the predominant species is *T. inkin* [1, 7, 10, 19, 21, 27–31]. In our series, *T. inkin* was isolated in 78% of the cases and to a lesser extent *T. cutaneum* and *T. ovoides*.

As shown in Table 2, morphological identification only allows us to determine the genus; through automated systems we can obtain a specificity of up to 85.7%, and with proteomic techniques such as the MALDI-TOF MS system, the specificity of the diagnosis rises to 100%. It is a method in which diagnosis is obtained in the precise path of a protein footprint, i.e., it depends on the proteins of each microorganism, therefore also being a simple and quick method (between 10 and 30 min) [2, 8, 27, 32]. This method has been correlated with the gold standard, which is molecular biology, through PCR, with the molecular target of choice IGS1 and of lesser precision by spacers IT1 and ITS2 (all fractions of genes rDNA). However, this methodology is slower [2, 6].

In general, the treatment of WP is simple; most of the reports used antifungal shampoos, the most effective be-

ing 2% ketoconazole. Other less studied schemes include shampoos with cyclopiroxolamine. In our study, an improvement of 80% was obtained with the daily application of 2% ketoconazole shampoo for about 1 month. However, there are some cases, commonly in patients with wooly, long hair in which humidity is maintained in a prolonged way, where the antifungal shampoo as monotherapy is insufficient and it is necessary to use an oral antifungal such as itraconazole or keratolytics such as salicylic acid [1, 4, 11, 33].

To conclude, WP is a rare mycosis, with a prevalence in girls aged <15 years. Most of the cases are associated with long hair and excessive moisture, and about 80% of the cases were caused by *T. inkin*. The identification by proteomics with the system MALDI-TOF MS allows us to identify species in a short time. Topical ketoconazole continues to be a useful treatment option for most cases of WP.

Statement of Ethics

All subjects gave informed consent and the study protocol was approved by the institute's committee on human research.

Disclosure Statement

The authors declare no conflicts of interest. This work did not receive any support.

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