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Cercarial dermatitis: Clinical course and prevention

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ABSTRACT

Introduction: Cercarial dermatitis (swimmer's itch) is a water-borne parasitic skin disease caused by larvae (cercariae) of a nonhuman species of schistosome. The prevailing symptoms are nodulopapular skin lesions accompanied by pruritus. The condition occurs virtually worldwide and is considered to be an emerging public health problem in Europe. In most cases, the symptoms are associated with cercariae of avian schistosomes of the genus *Trichobilharzia* spp.

Aim: The aim of this review article is to present the most important information on the course of the disease, its diagnostics, treatment and epidemiology. Additionally, it offers an account of preventive measures targeted at reducing the risk of infection.

Material and methods: A literature search was conducted using electronic databases such as PubMed, Google Scholar and Willey Online Library. Altogether, 40 articles were subject to analysis.

Results and discussion: The data obtained from the literature survey process were systematised and presented in 5 sections. Clinically, effective control of swimmer's itch should comprise measures from the fields of diagnostics, treatment, epidemiology and prevention.

Conclusions: Swimmer's itch poses diagnostic difficulties, primarily due to the low specificity of its symptoms. Owing to a lack of conclusive data on the fate of cercariae penetrating human skin and a growing number of documented cases of cercarial dermatitis worldwide, further intensive research into the matter is warranted.

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1. INTRODUCTION

Swimmer's itch or cercarial dermatitis is a water-borne parasitic skin disease caused by cercariae of avian schistosomes.[1] Its predominant symptoms are maculopapular skin lesions accompanied by intense itching.[2] In some cases, additional symptoms may appear including nausea, fever, cough, diarrhea and local lymph node swelling.[1] The life cycle of an avian schistosome involves two main hosts: an intermediate (typically freshwater snails commonly found in water bodies, such as *Lymnaea stagnalis*, *Radix auricularia*, *Stagnicola palustris*) and a definitive host (a number of water bird species, e.g. *Anas platyrhynchos*, *Fulica atra*, *Podiceps cristatus*). Humans become an accidental host, and, as a result, the parasite fails to undergo a complete development.[3]

Cercarial dermatitis has been reported worldwide, with the only exception being the continent of Antarctica.[1] In European water bodies, swimmer's itch is associated with the occurrence of the schistosome species mainly represented by the genus *Trichobilharzia*.[4] Humans become infected through swimming or wading in freshwater, where pathogenic cercariae can be found. In our climate zone, the infections are usually observed in warm summer months.[5]

Low detection rates of this condition may be due to its rather nonspecific symptoms of varied intensity, which are largely dependent on the number of larvae penetrating the skin and an individual's immune hypersensitivity.[6]

Despite the progress made over the last decades in the understanding of swimmer's itch, our knowledge of the pathogenesis, diagnostics and geographical distribution of the disease remains inadequate. Both in Poland and worldwide, there are regular reports of swimmer's itch outbreaks. The condition itself carries negative connotations, as the idea of parasites penetrating the skin while bathing in a water body has the potential to cause a strong emotional reaction. Due to this single reason, a lot of people are ready to reduce or totally refrain from activities such as swimming or bathing in recreational waters. Therefore, swimmer's itch is a potential threat, both in medical and economic terms, to people working in an aquatic environment and to those employed in tourism.

2. AIM

The aim of this paper is to present the most important information about cercarial dermatitis in humans. This paper will contribute to a better understanding of the disease, its treatment, diagnostics and clinical presentation. Additionally, it offers an account of preventive measures targeted at reducing the risk of infection.

3. MATERIAL AND METHODS

This article was based on a literature search using electronic databases such as PubMed, Google Scholar and Willey Online Library. Keywords used in the article search were: 'bird schistosomes,' 'cercarial dermatitis,' 'swimmer's itch' and '*Trichobilharzia*.' Altogether, 40 selected articles were subject to analysis.

4. RESULTS AND DISCUSSION

4.1. Epidemiology

The disease occurs worldwide and is considered to be an emerging public health problem in Europe.[7] Cercarial dermatitis is associated mainly with freshwater bodies (lakes, ponds, streams, irrigation ditches and even rice fields), and, less commonly, salt water reservoirs.[5] It has been reported in many European countries, including Great Britain, Iceland, Norway, Austria and France.[8–12]

To date, in Poland there have been few confirmed cases of swimmer's itch in humans, including the Dzierżęcinka River-Water Valley and Lake Pluszne in North-Eastern Poland.[13,14]

In our climate zone, cercarial dermatitis occurs seasonally, which correlates with increased human activity in a water environment. The condition affects both sexes and all age groups.[15] Cercariae are released from snails in large numbers, especially on warm sunny days. For instance, one snail (*Lymnaea stagnalis*) infected with *Trichobilharzia szidati* can, on average, expel 2,621 cercariae per day.[16] Another factor implicated in causing infections in people is the time of day. Most cercariae are released from snails during morning hours, which may lead to an increased risk of infection in individuals swimming between 6 and 10 a.m.[15] Moreover, the rise in recreational water activities, such as bathing, seen on hot days, and thus longer exposure to water, contributes to a higher risk of developing cercarial dermatitis.[17]

Owing to the fact that the development of parasites is seasonal and temperature-related, climate change and global warming are considered to be important determinants of *Trichobilharzia* infection risk.[4] Higher temperatures, being the result of climate change, may create optimal conditions both for snails to develop and for migratory birds to stay for winter, which is associated with a longer parasite transmission period and their greater distribution in water bodies.[18]

4.2. Etiology and pathogenesis

Although swimmer's itch had been reported before, the symptoms of the disease were first associated with avian schistosomes in 1928 by Cort.[19]

The key stage in the life cycle of avian schistosomes is the penetration of host skin by cercariae (Figure 1). Research has shown that one of the factors accounting for accidental infections in humans is the similarity between some lipid components in the integument of birds and humans.[20] In the case of *T. szidati*, the time required for the penetration of human skin to commence is about 8 s, while complete penetration occurs within 4 minutes.[21] The severity of symptoms and the time in which the reaction appears depend, among others, on individual sensitivity, the number of cercariae penetrating human skin and on whether it is the

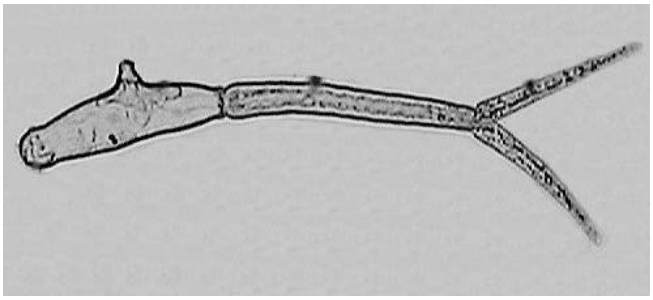

Figure 1. Cercaria of *Trichobilharzia* sp. (invasive stage for human).

Figure 2. Erythematous papules cause by cercariae of *Trichobilharzia* sp. (1 day after infection).

first or repeated exposure to the pathogen.[22] Skin lesion are most commonly seen on the legs, torso and forearms.[13]

Following the first contact with the parasite, the skin reaction is not very severe for most people. It is characterised by the occurrence of a macular or maculopapular rash, 1–2 mm in diameter at the sites of skin exposure to cercariae. This phase lasts, on average, 12–48 h post infection (p.i.). In some cases, the reaction may be delayed and the lesions may appear 8 days p.i. Repeated contact with cercariae results in a sensitization phenomenon that precipitates a hypersensitivity reaction.[1,23] Consequently, infection is characterized by greater specificity than what is observed in primary infections, due to the intensity of skin symptoms. After 4–20 minutes, most people develop macules (up to 10 mm in diameter) with primary itching. Then, 2–3 days p.i., the formation of vesicles on papules (1–8 mm in diameter) can be observed (Figure 2). Moreover, scratching may lead to secondary bacterial infections. Skin symptoms begin to resolve about 10 days p.i. Histopathological investigations have demonstrated the presence of leukocytes (3–9 h p.i.), limfocytes (24 h p.i.) and histiocytes (36–52 h p.i.) in response to the presence of schistosomula of *Trichobilhazia*. Degradation of the parasites in the skin begin 24h p.i. and after 36h p.i. they will be completely destroyed. Tissue repair begins after about 72h p.i. together with accompanying parakeratosis.[1,20]

It should be noted that some skin lesions may be considerably bigger than others. It is most likely caused by the penetration of skin by several cercariae at one site. The skin area affected becomes warm to the touch, swollen and painful. Additionally, the patient may experience stinging and occasionally burning at the site of cercariae penetration.[2]

Moreover, generalised symptoms may appear, such as: elevated body temperature, lymph node enlargement and swelling, nausea and diarrhea, and also symptoms of anaphylactic shock as well as respiratory system disorders.[20]

To date, the results of several studies have proven to be inconclusive and have failed to either confirm or exclude the migration of larvae further beyond the skin barrier in humans.[24]

However, as studies involving mammalian models have demonstrated, the cercariae of avian schistosomes managed to break the skin barrier and were able to reach a number of organs including the lungs, liver, heart, kidneys and spinal cord, undergoing transformation into schistosomules.[24,25]

4.3. Diagnosis and treatment

Cercarial dermatitis is characterised by poor detection rates, which is connected with a low specificity of the condition's symptoms.[1] Its manifestations can be mistaken for insect bites, allergic reactions or nodular prurigo (*prurigo nodularis*).[26] The lesions are commonly thought to be caused by other factors, such as algae or cyanobacteria. Additionally, some cases of swimmer's itch remain undetected, particularly if the symptoms are mild.[27,28]

Making the diagnosis is, in most cases, based on the medical history and clinical presentation.[15] While taking a medical history, other possible causes of skin lesions should be identified and excluded. The most important diagnostic criteria are: swimming in a natural water body over the last 24 h prior to the appearance of symptoms, skin lesions of a papulopustular character accompanied by intense itching, as well as lesions affecting only those parts of the body which were exposed to water.[1]

Laboratory diagnostics include histological techniques and blood investigations.[29] The results of biopsy, if performed, are often inconclusive. Cercariae die in skin within 24 h from the onset of infection, and after 72 h they undergo degradation.[30] Consequently, histological investigations do not always lead to the detection of the etiological agent.[29]

Since dermatitis is a type of allergic reaction, laboratory tests may detect an increased eosinophil count and elevated

immunoglobulin E (IgE) levels.[1] It has been demonstrated that *T. regenti* cercariae trigger the release of IL-4 from basophils, which stimulates differentiation of monocytes into type II macrophages, which are involved in the inhibition of the inflammatory process.[29,31] An analysis of blood sera collected from 58 patients with a past history of swimmer's itch, revealed elevated IgG levels.

Research has shown that skin tests which are based on an injection of antigen (homogenized cercariae), followed by an assessment of skin lesions at the injection site, are neither sufficiently specific nor sensitive.[29] Moreover, dermatological diagnostics should be complemented by parasitological investigations including detection of parasites in a particular water body.

The treatment involves the use of antipruritic agents and oral antihistamine drugs, with topical glucocorticosteroids recommended for difficult to treat cases.[26,30,32] Moreover, Burkhart and Burkhart[33] proposed that in the early stage of the disease, systemic treatment with ivermectin should be considered, as the majority of schistosomes causing swimmer's itch are sensitive to this medication. Additionally, patients should be given guidance concerning skin care and pruritus reduction, with the following recommendations: avoiding overheating, sweating and hot showers, applying cooling packs and eliminating potentially irritating cosmetics as well as wearing clothes made of natural fabrics. In order to prevent scratching, delicate compression of itchy places is advisable. Alcohol, spicy and hot dishes should be avoided in the diet.[34]

The type of therapy chosen depends on the extent of cercariae-induced skin lesions, the patient's age and individual contraindications. Owing to cercariae histolysis in the dermis occurring in most patients, gradual resolution of symptoms is seen within about 3 weeks.[23]

4.4. Prevention

The member countries of the European Union are required to test water in bathing sites for microbiological threats (*Escherichia coli* and *Enterococcus*), the presence of cyanobacteria bloom and environmental pollutants (glass, plastic).[35] The above mentioned analyses do not include tests targeted at the detection of avian schistosomes. The problem is publicised only with an outbreak of the disease. Its probability can be assessed before the recreational season starts, through parasitological investigations for the presence of intermediate hosts or through testing water samples for the presence of cercariae.[36]

The reports of swimmer's itch cases are followed by attempts to disturb the life cycle of parasites by eliminating the free-swimming larvae or keeping control of intermediate and final host populations.[28,37]

Moreover, Wulff et al.[38] conducted studies on the efficacy of 9 topical agents to be used directly on skin, which were supposed to minimise the risk of cercariae infection. A high level of protection against infections was achieved for a commercially available anti-jellyfish lotion Safe Sea and for a mixture of a sunscreen with 0.05% niclosamide.

A better solution to the problem seems to be the use of basic preventive measures such as refraining from feeding waterfowl, avoiding shallow waters near the shoreline or places abounding in water vegetation, reducing time spent in water during morning hours, as well as drying the skin with a towel directly after bathing. An important aspect is keeping the local residents informed about the possible negative effects of swimming in surface waters and also providing clear messages about the potential threat, for example by placing notice boards about swimmer's itch at bathing sites where the problem is encountered.[39,40]

6. CONCLUSIONS

(1) Swimmer's itch poses diagnostic problems, which is primarily due to its rather non-specific symptoms. Moreover, there is a need for the development and implementation of specific and sensitive diagnostic tools.
(2) Owing to a lack of conclusive evidence on the fate of cercariae penetrating human skin and a growing number of documented cases of cercarial dermatitis worldwide, further intensive research into the matter is warranted.
(3) Prophylaxis should include both raising public awareness of the problem and using personal preventive measures. Along with this, the implementation of a registration system for cercarial dermatitis in humans in particular areas should be considered.

Conflict of interest

None declared.

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