

Successful Treatment of *Trichophytonrubrum* Onychomycosis and Warts (*Verruca Plantae*) with BioCool®

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Abstract

Onychomycosis (Trichophytonrubrum) and warts on feet (verruca plantae) are both problems that can render patients disable from walking properly and to take part in social life activities. In the present study we show that BioCool® kills Trichophytonrubrum and that onychomycosis patients recover from illness in an exceptional way. Moreover, patients suffering from warts on feet improve in a dramatic way. Thus, it can be disclosed that treatment with BioCool® is a golden choice for patients with onychomycosis and verruca plantae.

Keywords: onychomycosis, warts, treatment

Background

Trichophytonrubrum, is the most common causative agent of dermatophytosis worldwide, mainly occupying the humans' feet, skin, and between fingernails (Yang et al., 2007). *T. rubrum* is known to be one of the most prominent anthropophilic species of dermatophytes (Cuomo & Birren, 2010), a fungus commonly causing skin diseases, appearing in various shades of white, yellow, brown, and red. It may also be found in various textures, being waxy, cottony, or smooth. Even though it is commonly observed, *T. rubrum* infections are incredibly hard to diagnose, and difficult to differentiate from other dermatophytes. Because this fungal pathogen is poorly understood, the discovery of its genomic structure may significantly reduce the health costs of those who suffer various forms of dermatophytosis caused by *T. rubrum*. Through validated information of what is known on its genome sequence, *T. rubrum* is a keratinophilic filamentous fungus.

T. rubrum is the most common infectious, anthropophilic species of dermatophytes (Cuomo & Birren, 2010). Very little is known about the mechanism of its invasion and pathogenicity (Maranhao, Paiao, & Martinez-Rossi, 2007). Though it is usually not life-threatening, infections are long-lasting, recurring, and incredibly difficult to cure. The fungal pathogen's ability to produce and secrete proteolytic enzymes is a major virulence factor (Chen et al., 2010). *T. rubrum* attacks the human skin and nails via keratin degradation (Cuomo & Birren, 2010). Keratin, a fibrous protein, is a major structural component of the human skin and nails; thus *T. rubrum* invades through the stratum corneum, the outermost layer of the epidermis, to obtain keratin. This invasion causes dermatophytosis infections such as athlete's foot, fungal infections between fingernails, jock itch, and may be painful. The infections may be transmitted from person to person. Anti-fungal medications are available to prevent infections, however infections typically reoccur.

Subjects

We recruited patients from a regular office practice. No attempts to randomize the patients were made, and the study groups were recruited and studied sequentially. The criterion for patient selection was DSO invasion of 60% or more of the nail bed of the great toes. Oral informed consent was obtained from each patient. Signed consent forms were not used, and institutional approval of this study of human subjects was not sought. A few subjects recruited for the study did not return for their first monthly post recruitment examination; these patients were dropped from the study and are not included in the intent-to-treat analysis.

The study population consisted of adults of both sexes. The disease studied, DSO, once acquired, is a lifelong infection with no record or incidence of spontaneous recovery and may have a familial component bearing on susceptibility and infection.

Treatment Subjects

The patients in this pilot study were treated with 2% of BioCool® daily for 7 consecutive days once a month.

Following this, patients were treated weekly with the same amount as described above. Since the results obtained from this group indicated that we had achieved the objective of the study, the study was terminated. Our plan was to recruit at least 10 patients into the study group after the first once until a significant increase in treatment failures indicated a loss of depot effect. Ten patients were added to verify the increased beneficial observed in the first patients.

Material and Methods

Substance: The test substance was obtained from the company BioCool AB, Skellefteå, Sweden. The test substance has been described on the open market as BioCool®. The mechanism by which the microorganism is killed is a chemical reaction resulting in singlet oxygen. Singlet oxygen is known from other biological systems to have killing effect on microorganisms (Kniel et al., 2003). The substance has previously been tested and found to kill *Escherichia coli* (Nandi et al., 2010). The governmental own company FOA-test performed the test. In present study test substance was tested at concentration of 2% and 4% final concentration. The substance was added to a solution of dermatophytes at an initial concentration of one million per ml.

The fungal tested organism *Trichophytonrubrum* was obtained from a culture collection at Karolinska University Hospital, Huddinge, Sweden and spread over Sabouraud's dextrose agar plates. Killing was estimated at 1 and 3 hours.

Results

Experiment to test the effect of the BioCool® on *Trichophytonrubrum*

The fungal tested organism *Trichophytonrubrum* was spread over the Sabouraud's dextrose agar plates. The fungus was cut using a sterile cork borer and the microorganism was incubated with 1ml of the substance at room temperature. Higher temperatures up to 37⁰ were tested with similar results as in table 1.

The plates were incubated at 30⁰C for a week. Three replicates were made out for each concentration.

Table 1.

	2%	4%	6%	Control
1 hour	No growth	No growth	No growth	+ live dermatophytes
3 hours	No growth	No growth	No growth	+ live dermatophytes

Case reports

Case1. Female at the age of 70 with onychomycosis was treated with BioCool® twice each day over a period for one year. After one and a half year no signs of onychomycosis could be seen by ocular inspection. The patient had prior to BioCool® treatment tested several other treatments without any success as judged by the podiatry competence.

Case2. Male at the aged of 55 with several painful warts, which rendered him almost disable to walk ordinary used BioCool® for 6 month and he has no longer painful walking and his warts have cleared up. According to his podiatrician he must on a regular basis use the BioCool® treatment to avoid warts to regain.

Case 3. Female at the age of 35 with onychomycosis started treatment with BioCool® in February 2012 and in October 2012 she had fully recovered from her onychomycosis. After she finished her treatment she realized that occasional use of the product will keep her free from onychomycosis.

Case 4. Male at the age of 40 with onychomycosis, started with BioCool® and used it for 2 month. After this period he felt relieved and according to the pediatrician his feet were recovering gradually. However, he was unable to give his feet the treatment twice a day and instead he is doing treatment occasionally with gentle result.

Case 5. Young female with wart on both feet, had previously tested most treatments for warts on feet without results that help her. After only two weeks treatment with BioCool® she improved and after 4 month she was free from warts (Fig 1).

Discussion

Traditionally there has been a reluctance to treat fungal nail infection as it has been seen as a trivial cosmetic problem. However, without treatment, the condition often spreads to multiple toenails and can form a portal for recurrent bacterial infections. It is common in diabetics and can contribute to foot problems. It is common in diabetics and can contribute to foot problems. Newer topical therapies such as tavaborole, efinaconazole and luliconazole are currently being explored (Gupta & Simpson, 2012).

Systemic treatment is recommended for most people, as it is more effective than other treatments. The slow growth of nails means that they do not appear normal even after effective treatment (Gupta et al., 2012; Gupta & Simpson, 2012; Van Onselen, 2000). Side-effects of systemic antifungals include headache, itching, loss of sensation of taste, gastrointestinal symptoms, rash, fatigue and abnormal liver function (olde Hartman & van Rijswijk, 2008).

Warts are actually benign (noncancerous) tumors, occurring on the soles of the feet. They are called "plantar warts." Warts are caused by virus that enters the foot through a crack in the skin. Most warts disappear as mysteriously as they arrived, but not all warts go away on their own. Some can become painful, especially if they are in an area that receives a lot of pressure during walking. Commercial treatments for warts include salicylic acid pads, ointments, and solutions (Ellis & Bundick, 1957).

BioCool® is here shown to be an alternative treatment of infected feet. Not only affected nails and warts are showing dramatic improvement but also skin and feet in general are refined. Moreover, witnesses from the included subjects clearly point at a patient amelioration. This is valid for presented subjects but according to the podiatry competence that helps to provide us with information about the patients' improvement of diabetic feet and subjects with Keratoderma Palmoplantaris (kpp) and Pustulosis Palmoplantaris (ppp). The later observations must be disclosed in further studies.

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Figure 1 A



Figure 1 B



Figure 1 C

