CASE REPORT

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A dermatitis possibly due to contact with *Cyanophyceae*: a case report from a rural area in Indonesia

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ABSTRACT

Background: Diagnosing skin conditions can be challenging in resource-limited settings. *Cyanophyceae*, or blue-green algae, are found in water bodies worldwide and can lead to harmful algal blooms under specific conditions. East Nusa Tenggara, a province in eastern Indonesia, with its hot, dry climate and pristine waters, creates ideal conditions for these blooms. While dermatitis from *Cyanophyceae* exposure is rare, the potent biotoxins produced by these algae may cause skin reactions. This case report aimed to describe the dermatitis that was possibly caused by *Cyanophyceae*.

Case description: A 22-year-old male from rural East Nusa Tenggara presented with pruritic papules, pustules, and vesicles on both arms for two days. The lesions began as erythematous papulo-vesicular formations and progressed to oozing and crusting shortly after he cleaned a neglected fish pond with algal blooms. The eruptions were confined to exposed areas of both arms. The patient reported no fever, cough, headache, or throat pain, and other physical findings were normal. After two weeks, the lesions improved significantly with topical mometasone furoate. The patient was educated on proper hand hygiene and avoiding similar allergens.

Conclusion: *Cyanophyceae* can release biotoxins that may cause hypersensitivity reactions on human skin. In addition, the lipopolysaccharides found in their cell walls can also irritate human skin. Skin reactions vary and depend on factors such as individual susceptibility, cyanobacterial profile, toxin types and concentrations, and skin barrier disruption. Cyanophyceae can cause irritation and allergic responses.

Keywords: Blue-green algae, *Cyanophyceae*, dermatitis, East Nusa Tenggara.
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INTRODUCTION

Cyanophyceae, or more commonly known as blue-green algae, is known to rarely cause pruritic rashes in humans. *Cyanophyceae* are found in bodies of water all over the world, and can flourish into harmful algal blooms under favourable water and weather conditions. *Cyanophyceae* produce potent biotoxins that are known to penetrate the human skin.[1]

Although non-life-threatening, the lesion itself is known to cause moderate discomfort through intense pruritic reactions, burning sensations, and possible skin barrier damage.[2] Indonesia, characterized by its extensive archipelago and tropical climate, is home to numerous freshwater lakes, rivers, and wetlands, especially in rural regions. The hot tropical sunlight combined with the pristine water conditions in East Nusa Tenggara provides an ideal growth condition for algal blooms in water bodies.[1,2] Here we present a case report of a twenty-two-year-old male with dermatitis possibly caused by *Cyanophyceae* in a rural area of East Nusa Tenggara, and we aim to shed light on the importance of diagnosis and treatment of skin diseases in a low-resource setting.

CASE REPORT

A 22-year-old male presented to a primary care facility in Noemuti, East Nusa Tenggara with multiple pruritic papules, pustules, and vesicles on both arms for 2 days before admission. The lesions initially started with erythematous papulo-vesicular which on occasions had progressed to oozing and crusting. The patient is a construction worker. Upon further questioning, he revealed that the lesion erupted after he cleaned a neglected fish pond full of an algal bloom. The patient stated that he scrubbed the outer linings from outside of the pond and therefore came into contact with the contaminated water, mostly on his arm region. The lesion appeared around one to two hours after cleaning. No snails were found in the pond. He has worked around the pond and come into contact with the grass and plants around the pond before, but no complaints have been stated. The patient denied a recent history of fever, cough, headaches, and odynophagia. The patient did not take any medications and has no history of chronic illnesses such as type 2 diabetes, hypertension, dyslipidemia, or any atopic diseases. There were no similar complaints among his family members.

On physical examination, the vital

Figure 1. Lesion on the right arm (A) and the left arm (B).

signs are within normal limits. Head and neck examinations revealed no lymph node enlargement. Heart, pulmonary, and abdominal examinations were insignificant. A skin eruption was limited to both the right and left arms and both palms. Lesions on the palm were fewer in number. Dermatological examination of the right arm showed multiple papules, pustules, vesicles with crust, and excoriations. Dermatological findings on the left arm were similar, with additional crust on the antecubital fossa (Figure 1).

The patient was diagnosed with contact dermatitis, suspected due to *Cyanophyceae* and given topical mometasone furoate cream once daily. The patient was also educated on improving his hand hygiene, using personal protective equipment like hand gloves, and avoiding any similar allergens. Further follow-up after 2 weeks revealed that the lesion had subsided significantly, with only complaints of mild pruritus by the patient.

DISCUSSION

Cyanophycea, sometimes referred to as blue-green algae, are frequently found in freshwater lakes and reservoirs globally.[3] In recent years, numerous studies have shown that the increasing levels of nitrogen and phosphorus in waters, as well as rising CO_2 levels in the atmosphere, have led to the rapid growth and proliferation of cyanobacteria.[4-6] *Cyanophyceae* or cyanobacteria have been reported to cause irritant and allergic contact dermatitis and also generalized urticarial rash. Many cases of skin rashes linked to cyanobacteria occur due to recreational or occupational activities in water tainted with these organisms. Skin contact with cyanobacteria is a significant way of exposure.[6,7] Cyanobacteria are a group of prokaryotic, autotrophic microorganisms that possess photosynthetic pigments. 80 species are known to produce harmful toxic metabolites. These toxins include alkaloids, cyclic peptides, and lipopolysaccharides, which can have a range of health effects, including hepatotoxicity, neurotoxicity, cytotoxicity, and dermatotoxicity.[7]

Cyanotoxins are mainly released during the rapid growth phase known as blue-green algae blooms, which occur when specific cyanobacterial species reproduce en masse over several days, resulting in a blue-green coloration of the water, along with foam, scum, or mats on the surface. There are nearly 300 known cyanotoxins and more than 2000 cyanobacterial secondary metabolites that have been reported from various sources.[8] The risk of direct exposure to cyanotoxins is greatest during the summer and early autumn months.[9] Cyanotoxin exposure route can be through ingestion, inhalation, and dermal contact.[10] Dermatoxins found in some *Cyanophyceae* species primarily consisted of lyngbyatoxin, aplysiatoxin, and debromoaplysiatoxin. These toxins have been shown to activate the body's inflammatory responses. Direct contact with Aplysia and debromoaplysiatoxin-contaminated water caused acute skin irritation, rashes, and blisters.[9] Lipopolysaccharides (LPSs) found in the cell walls of cyanobacteria can trigger irritant and allergic reactions in the tissues of humans and animals that come into contact. In vitro studies showed that LPS in cyanobacteria triggers inflammation by producing interleukin (IL)-8, C-C motif chemokine ligand (CCL)2, and CCL20 in keratinocytes.[11] These algae are also known to occur on man-made structures such as fish ponds.[12]

Dermatoses associated with cyanobacteria can occur through various molecular mechanisms, leading to differing clinical presentations. Factors contributing to this variability include individual susceptibility, the specific cyanobacterial profile in water bodies, the types and concentrations of cyanotoxins, disruption of the skin barrier due to prolonged exposure to water, and the effects of ultraviolet irradiation (which may be phototoxic or immunosuppressive).[6] Pruritic skin rashes after recreational or occupational exposure to cyanobacteria in association with exposure to freshwater cyanobacteria and their cytotoxins are infrequently reported.[13] Skin manifestations essentially are a form of contact dermatitis, characterized by a gradual onset of itching and burning that eventually develops into visible dermatitis. This includes redness, blistering, and significant peeling, resulting in moist, bright red, tender, and painful areas, particularly in the genital and perianal regions. Whether cyanobacteria-associated cutaneous eruptions in susceptible individuals are primarily irritant reactions, immediate hypersensitivity, or delayed contact hypersensitivity responses is also reported.[6]

The patient's symptoms arose following exposure to water from a neglected pond, prompting the need to differentiate this case from other dermatologic conditions associated with freshwater exposure.[14] Conditions such as schistosomiasis should be considered, but there were no snails, birds, or swans, which are hosts of Schistosoma, found in the pond.[15] Otherwise, Schistosoma were mostly

found in endemic areas of Indonesia, such as Sulawesi, not in East Nusa Tenggara.[14,15] Additionally, the aggravating effects of water on pre-existing dermatitis were ruled out because there was no history of pre-existing dermatitis. Contact dermatitis caused by plants found along the pond was ruled out. Lesions were not observed when the patient worked among various types of grass and weeds.[16] The lack of dermatitis on the palms may indicate either minimal prolonged contact or reduced sensitivity of the palm skin compared to other areas. Furthermore, the thickened outer skin layer on the palms may serve as a protective barrier, limiting the entry of irritants or allergens. However, this finding might also suggest a non-allergic response, such as irritant contact dermatitis, instead of allergic contact dermatitis. An appropriate skin patch test could provide further clarification to confirm or exclude the presence of an allergy.

Skin patch tests are the gold standard for contact dermatitis diagnosis.[17] Skin patch testing with cyanobacterial preparations, interpreted by The International Contact Dermatitis Research Group (ICDRG), should be employed as a diagnostic procedure to investigate the constituent allergen of water-related contact dermatitis.[18] Laboratory studies, like complete blood count, transepidermal water loss (TEWL) measurement to measure the skin barrier function, and skin biopsy, can also be done.[19] However, due to our primary healthcare center's limited resources, we were unable to perform the patch testing. An open skin contact test with the suspected contact allergen could be an alternative. In this case, we didn't do any since it was difficult to obtain the exact species of *Cyanophyceae* that had grown in the pond, as the patient had cleaned the pond earlier.

Nevertheless, based on clinical judgment of the patient's history of exposure to blue-green algae, combined with visible lesions to the area of direct exposure (specifically the arms), supported by local knowledge of pathogen epidemiological data, and the acute presentation of multiple pruritic papules, pustules, and vesicles that progressed to oozing and crusting, could lead to the diagnosis of contact dermatitis. Allergen avoidance is the mainstay of treatment.[18] Educating patients to avoid allergens, hand washing, and glove use is important for future outcomes. Treatments include antihistamine, topical steroid for two to three weeks of use, and oral prednisone for severe or widespread eruptions are usually needed.[18,19]

CONCLUSION

This case report highlights the potential for *Cyanophyceae* exposure to cause dermatitis in individuals, particularly in rural areas with frequent algal blooms, such as East Nusa Tenggara, Indonesia. The 22-year-old male patient developed pruritic skin lesions following contact with contaminated water while cleaning a fish pond, illustrating the importance of recognizing and diagnosing cyanobacterial-related skin conditions. Effective management, including avoidance of allergens and appropriate medical treatment, led to significant improvement in the patient's symptoms. This case underscores the need for increased awareness and preventive measures in low-resource settings to mitigate the risks associated with exposure to blue-green algae.

ETHICS IN PUBLICATION

The patient received informed consent and agreed to share his clinical picture for publication.

CONFLICT OF INTEREST

The authors have no conflict of interest.

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AUTHOR CONTRIBUTIONS

Authors CAS and MT performed and contributed to patient examination, treatment, follow-up, medication, reference finding, manuscript preparation, and publication, while authors FC and PBJ contributed on reference finding, manuscript preparation, and publication.

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