Hot Tub-Associated Pseudomonas Folliculitis: A Case Report and Review of Host Risk Factors

Joanne S. Jacob 1, Jaime Tschen 2

1. Dermatology, Baylor College of Medicine, Houston, USA  2. Dermatology, St. Joseph Dermatopathology, Houston, USA

Abstract

_Pseudomonas aeruginosa_ folliculitis is an infection of the skin commonly associated with swimming pool and hot tub use. It often presents as outbreaks affecting multiple individuals using the same contaminated public water facility. We present a case report of a 50-year-old woman who developed pseudomonal folliculitis after using a hot tub with multiple family members. No other family member developed folliculitis. Factors contributing to susceptibility to _P. aeruginosa_ infection are reviewed.

Categories: Dermatology
Keywords: pseudomonas, folliculitis, hot, tub, pool, cutaneous, flora, diabetes

Introduction

_Pseudomonas aeruginosa_ folliculitis is an infection of the skin commonly associated with swimming pool and hot tub use. It is estimated that 67% of hot tubs and 63% of swimming pools are contaminated by _P. aeruginosa_ at any single point [1]. Due to its association with public facilities, it often presents as outbreaks affecting multiple individuals [2]. We present a case report of a 50-year-old woman who developed pseudomonal folliculitis after using a hot tub with multiple family members. No other family member developed folliculitis.

Case Presentation

A 50-year-old woman presented for evaluation of an itchy rash on the skin. Two days prior to presentation, the patient spent several hours in a hot tub that multiple family members also used on the same day. It appears the patient used the hot tub for a longer and more continuous time than her family members. No other family member developed a rash. The patient has an allergy to iodine and uses fexofenadine for seasonal allergies. She uses ibuprofen for occasional pain relief.

Physical examination revealed pruritic papules and pustules on the chest, back, and buttocks (Figures 1-3). Dermoscopy of a single lesion demonstrated a pustule with a central punctum on an erythematous base (Figure 4). Involved areas were occluded by swimwear when using the hot tub. A wound culture of a lesion on the back was collected. Clinical suspicion was for folliculitis, either by _Staphylococcus aureus_ or _P. aeruginosa_. The patient was empirically prescribed oral combination therapy 160 mg trimethoprim and 800 mg sulfamethoxazole twice daily and topical neomycin/polymyxin B/bacitracin ointment twice daily.
FIGURE 1: Clinical photo of patient’s back
Distribution of papules and pustules seen involves areas occluded by clothing or swim wear, which is characteristic of pseudomonal folliculitis.

FIGURE 2: Clinical photo of patient’s upper buttocks
Consistent with the lesions on the back, distribution of pruritic papules and pustules is on clothing-occluded areas of the patient’s skin.
On closer examination, follicular arrangement of papules and pustules is more evident.

Dermoscopy of one lesion demonstrated a pustule with a central punctum on an erythematous base.

The culture of the wound revealed *P. aeruginosa*. Antibiotic susceptibility showed the infectious organism to be broadly sensitive.

When the patient was called six days after presentation for follow-up of results and antibiotic susceptibility, the patient’s rash had resolved despite not being sensitive to trimethoprim-sulfamethoxazole combination.
Possible theories for why she alone developed pseudomonal folliculitis in females. In the presented patient, female gender, differences in skin flora, and length of time of exposure are three possibilities. Lotion and deodorant use are known to have a quantitative difference in the cutaneous flora between men and women when controlling for differences in topical product use, such as lotions and deodorants. Studies have demonstrated both qualitative and quantitative differences in the cutaneous flora between men and women. Many factors can affect the risk for a certain individual to contract pseudomonal folliculitis. These factors include changes in protective cutaneous flora, length of exposure, skin trauma, and gender.

It is a recognized phenomenon that *P. aeruginosa* infections can occur with changes in the flora of the skin. Chronic medical conditions such as diabetes can deplete normal cutaneous flora. Oxidative stress from elevated blood glucose in diabetes leads to loss of protective cutaneous bacteria. This facilitates skin colonization by abnormal bacteria such as *P. aeruginosa*. Incidence of pathogenic bacterial colonization increases proportionally to blood glucose elevation.

Patients with impaired immune systems, either by malignancy or immunosuppressive medications, can also present with an imbalance of normal bacteria on the skin. One study demonstrated that when compared to a control group, patients with leukemia were predisposed to rapid colonization of gram-negative bacteria at all sampled body sites. This was thought to be attributable to a reduction in gram-positive bacteria that normally exclude pathogenic gram-negative bacteria, though the mechanism was not fully understood. A similar phenomenon was seen in chronic antibiotic use, particularly tetracyclines. These disruptions in protective cutaneous flora can leave an individual more vulnerable to water-borne exposure to *P. aeruginosa*.

Further associations have been made between pseudomonal folliculitis and behaviors in pools or hot tubs. Differences in gender of the individual can also influence the risk of pseudomonas folliculitis. In studies of pseudomonal folliculitis outbreaks, there were more women affected than men. Hypotheses to explain this disparity include intrinsic differences in skin flora between men and women and differing topical product use, such as lotions and deodorants. Studies have demonstrated both qualitative and quantitative differences in the cutaneous flora between men and women when controlling for differences in lotion and deodorant use. A combination of both factors may contribute to the greater incidence of pseudomonal folliculitis in females.

In the presented patient, female gender, differences in skin flora, and length of time of exposure are three possible theories for why she alone developed *P. aeruginosa* folliculitis. Her family members included both males and females so, while gender may have still contributed, it would not be the sole differentiating factor.
Though this patient is not known to have diabetes or to be immunocompromised, her cutaneous flora may differ from her family members. This unknown intrinsic difference could have contributed to her risk of bacterial carriage.

While it was difficult to quantify total time of exposure of different family members, it appears that she used the hot tub for a greater amount of continuous submersion and total time of use. This would have allowed for greater permeability of the stratum corneum and facilitated development of pseudomonas folliculitis.

Conclusions
Numerous factors may influence an individual's risk of developing *P. aeruginosa* folliculitis from an environmental exposure. These risk factors include changes to cutaneous flora, female gender, length of exposure, and skin trauma. It would be impractical to recommend all women avoid extended hot tub use. Additionally, patients with unhealed thermal burns of skin are not likely to use hot tubs or public pools. Thus, counseling should be directed to those with diabetes, immunocompromised states, or trauma of the skin. These populations can be educated on the risk of infection with extended submersion in public pools or hot tubs.

Additional Information
Disclosures
Human subjects: Consent was obtained by all participants in this study. Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: Payment/services info: All authors have declared that no financial support was received from any organization for the submitted work. Financial relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References
1. Lutz JK, Lee J: Prevalence and antimicrobial-resistance of *Pseudomonas aeruginosa* in swimming pools and hot tubs. Int J Environ Res Public Health. 2011, 8:554-564. 10.3390/ijerph8020554
2. Jacobson JA: Pool-associated *Pseudomonas aeruginosa* dermatitis and other bathing-associated infections. Infect Control. 1985, 6:398-401. 10.1017/s0195941700063475
3. Kanj SS, Kanafani ZA: Current concepts in antimicrobial therapy against resistant gram-negative organisms: extended-spectrum beta-lactamase-producing Enterobacteriaceae, carbapenem-resistant Enterobacteriaceae, and multidrug-resistant *Pseudomonas aeruginosa*. Mayo Clin Proc. 2011, 86:250-259. 10.4065/mcp.2010.0674
4. Luelmo-Aguilar J, Santandreu MS: Folliculitis: recognition and management. Am J Clin Dermatol. 2005, 5:301-310. 10.2165/00128071-200405050-00003
5. Rice SA, van den Akker B, Pomati F, Roser D: A risk assessment of *Pseudomonas aeruginosa* in swimming pools: a review. J Water Health. 2012, 10:181-196. 10.2166/jwh.2012.020
6. Kim JH, Ruegger PR, Lebig EG, et al.: High levels of oxidative stress create a microenvironment that significantly decreases the diversity of the microbiota in diabetic chronic wounds and promotes biofilm formation. Front Cell Infect Microbiol. 2020, 10:259-2020. 10.3389/fcimb.2020.00259
7. McBride ME, Duncan WC, Bodey GP, McBride CM: Microbial skin flora of selected cancer patients and hospital personnel. J Clin Microbiol. 1976, 5:14-20.
8. Böni R, Nehrhoff B: Treatment of gram-negative folliculitis in patients with acne. Am J Clin Dermatol. 2003, 4:273-276. 10.2165/00128071-200304040-00005
9. Solomon SL: Host factors in whirlpool-associated *Pseudomonas aeruginosa* skin disease. Infect Control. 1985, 6:402-406. 10.1017/s0195941700063487
10. Altintas MA, Altintas AA, Guggenheim M, Busch KH, Niederbichler AD, Aust MC, Vogt PM: Is superficial burn caused by ultraviolet radiation (sunburn) comparable to superficial burn caused by heat—a histomorphological comparison by in vivo Reflectance-Mode–Confocal Microscopy. J Eur Acad Dermatol Venereol. 2009, 25:1389-1395. 10.1111/j.1468-3083.2009.03322.x
11. Marples BR: Sex, constancy, and skin bacteria. Arch Dermatol Res. 1982, 272:517-520. 10.1007/BF00509962