Short Report: Panton-Valentine Leukocidin-Positive *Staphylococcus aureus* Infections in Returning Travelers

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Abstract. Skin and soft tissue infections caused by Panton-Valentine leukocidin-producing strains of *Staphylococcus aureus* are emerging among travelers returning from the tropics. Here, we here present data on 15 affected individuals. Intrafamilial spread was documented in one case, and occupational transmission was assumed in another. *Spa* typing of the strains revealed a broad spectrum of variants, but some were clonally related. Methicillin-resistant *Staphylococcus aureus* (MRSA) was found in three cases.

Skin and soft tissue infections are a common cause of consultation in travelers returning from the tropics or subtropics.¹ In recent years, Panton-Valentine leukocidin (PVL)-producing strains of *Staphylococcus aureus* have begun to emerge in returning travelers.^{2–4} The PVL is a cytotoxin causing leukocyte destruction and tissue necrosis.⁵ *Staphylococcus aureus* strains, which produce PVL, can cause multiple recurrent skin infections and necrotizing pneumonia.^{6,7} Here, we present data on 15 patients returning from tropical and subtropical areas with skin and soft tissue infections caused by PVL-producing *S. aureus*. To our knowledge, this is the largest series described in returning leisure travelers.

From December 2005 to March 2010 we isolated PVL-producing *S. aureus* from 15 returning travelers who sought medical attention for skin and soft tissue infections in a travel clinic in Würzburg, southern Germany; a center that has 1,200 consultations per year. The majority of patients from the travel clinic population are returnees from the Asia/Pacific region (~60%), and Africa (30%, mostly sub-Saharan). Of the patients, 5 were male and 10 female (age range 8–56 years, mean 32 years). The purpose of travel was vacation, except for one patient, who was an immigrant visiting relatives in Africa. All patients complained about rapid progressive abscess formation, and 8 out of 15 reported newly emerging abscesses on different body sites (Figure 1). Prior to travel, no skin infections had existed. Although some cases were severe, there were no life-threatening courses of disease (Table 1). All patients were treated with beta-lactam antibiotics and clindamycin, and finally recovered. In methicillin-resistant *Staphylococcus aureus* (MRSA)-infected patients, treatment regimens were changed to clindamycin monotherapy (patients 14 and 15) or cotrimoxazole plus rifampicin (patient 12, because of clindamycin resistance). The patients were instructed about personal hygiene measures (i.e., not touching the abscess(es), hand disinfection). However, intrafamilial spread was noted in one household (patients 6 and 7). In this family, two additional members were affected clinically, but no samples were available for bacterial culture. In patient 3, a dentist, a possibly occupational spread to a nurse was assumed. The nurse reported on rapid progressive abscess formation on the face 3 days after the dentist had returned from her vacation. No samples could be obtained from this case, either. In only a small

proportion of the returnees, factors contributing to disintegration of the skin were distinctly reported. In two patients, dermal abscesses evolved shortly after contact to freshwater baths.

Bacterial strains were isolated by standard procedures, grown on Columbia blood agar (Becton Dickinson, Franklin Lakes, NJ), and identified as *S. aureus* by VITEK 2 (bioMérieux, Marcy-l'Etoile, France). Susceptibility testing was performed by VITEK 2. Oxacillin-resistant strains were subjected to *mecA*-polymerase chain reaction (PCR) for verification of MRSA.⁸ *Spa* typing was performed using the RIDOM Staphype database.⁹ For PVL-PCR, three bacterial colonies were harvested and boiled for 10 min in 500 µL of distilled water. After centrifugation, 5 µL of the supernatant was used for PCR in a reaction volume of 50 µL. Primers *lukSF*-forward (ATCATTAGGTAAAATGTCTGGACATGATCCA)⁷ and *lukSF*-reverse (GCATCAAGTGTATTGGATAGCAAAAGC)⁷ directed against the Panton-Valentine leukocidin chain S and F precursor genes (*lukS/F*-PV) were used. The known PVL-positive MRSA isolate VA17763 (*spa* type t008) served as positive control. After initial denaturation for 10 min at 95°C, 35 cycles were run with 94, 50, and 72°C for 1 min each, followed by a final extension step for 5 min at 72°C. *Spa* analysis revealed a broad spectrum of types, as expected for methicillin-sensitive *Staphylococcus aureus* (MSSA). The same t435 *spa* type could be demonstrated in the two affected family members who had returned from Egypt. As evidenced by based upon repeat pattern (BURP) analysis of the local *spa* type database,¹⁰ these types belong to a clonal cluster (*spa*-CC435), which also includes *spa* types t308 (found in the traveler from Turkey), and t159 (patients from Thailand, southeast Asia/Australia). The *spa* types found in the returnees from Brazil (t318), Dominican Republic (t665), and India (t1414) are members of the clonal cluster *spa*-CC012. In patients 12, 14, and 15, the PVL-producing strain was methicillin resistant.

Recent reports describe the emergence of PVL-associated staphylococcal diseases in travelers. Most often, skin and soft tissue infections were noted.^{2–4} However, a case of fatal necrotizing pneumonia after a stay in Africa has also been described.¹¹ Why travelers to foreign countries may be at risk of acquiring PVL-associated staphylococcal infections is not clear.² Previous antibiotic treatment of diarrheal disease or malaria has been hypothesized,^{2,12} also poor hygiene conditions and nasal carriage.¹² In the series described here, malaria prophylaxis was only taken by one person (patient 10). Personal hygiene was certainly an issue in many patients, leading to recurrent infections. Insect bites have been reported to

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FIGURE 1. (A) Rapidly evolving dermal abscess on the right hand of a 41-year-old patient who had returned from Thailand. (B) Cutaneous lesions on the left ankle of a 36-year-old traveler who had returned from Costa Rica. This figure appears in color at www.ajtmh.org.

serve as portal of entry in 5 of 9 cases,³ but were less frequently noted in our study. However, a point of entry is often not obvious.⁷ Interestingly two cases occurred shortly after prolonged contact to warm water of a hotel pool or steambath in our study. Subsequent transmission of the infection on returning has been reported.^{4,5,12} Intrafamilial spread and occupational transmission in one case was clinically evident in our study, but not proven microbiologically. Although we only identified

15 returning patients with lesions caused by PVL-producing *S. aureus*, the true incidence of this condition is presumably much higher as many travelers are certainly treated abroad or at home, and do not necessarily visit the travel clinic. Two previous studies have shown a large proportion of PVL-positive MRSA strains found in non-Irish and non-German ethnic origin individuals, possibly mirroring import to Ireland and Germany, respectively.^{3,13} In returning travelers, PVL-positive MRSA strains have been described in 2 out of 13 cases,² and 9 patients.³ In our study, 3 of the 15 strains were methicillin resistant. The polyclonal nature of PVL-positive MRSA strains was demonstrated in a small region of Germany and some cases were linked to international travel recently.³ *Spa* typing in our study showed a high diversity, which may be expected when examining MSSA. Few *spa* types were clonally related.

In conclusion, the history of rapid evolving and recurrent dermal abscesses is suspicious for a PVL-producing *S. aureus*, and culture followed by antimicrobial testing should be performed in each case. Prompt antibacterial chemotherapy should be initiated if clinically indicated, and patients should receive appropriate personal hygiene instructions to prevent recurrences and family or community spread. Future prospective studies should address the prevalence of PVL-positive *S. aureus* in returning travelers compared with the endemic PVL prevalence, and also in certain groups of travelers (i.e., budget versus luxury travel). Moreover, risk factors for the acquisition of PVL-producing *S. aureus* should be specified.

TABLE 1
Characteristics of returning travelers with infections caused by Pantone-Valentine leukocidin-producing *Staphylococcus aureus**

Patient no.	Age	Sex	Travel destination (duration)	Clinical presentation	Possible risk factors	<i>Spa</i> -type, clonal cluster† (strain no.)	Additional information
1	56	F	India (2 weeks)	Abscess on abdominal wall	—	t1414, <i>spa</i> -CC012 (VA2623)	MSSA
2	9	F	Canary Islands (2 weeks)	Abscesses on eyelid, later on arms, axillae, legs, gluteal	Pre-existing neurodermitis	t5942 (VA17057)	MSSA
3	26	F	Brazil (4 months)	Multiple abscesses on both thighs, labia and nose; later on buttocks	Multiple mosquito bites	t318, <i>spa</i> -CC012 (VA13764)	MSSA; possible occupational transmission to nurse
4	41	M	Thailand (4 weeks)	Abscess on right hand; later left shoulder, upper arm, and face	—	t159, <i>spa</i> -CC435 (VA8986)	MSSA
5	34	F	Turkey (1 week)	Abscesses on left lower arm; later on upper arm and back	Visit of steambath	t308, <i>spa</i> -CC435 (VA6990)	MSSA
6	42	M	Egypt (2 weeks)	Abscess on calf; later gluteal, on thigh and lower arm	—	t435, <i>spa</i> -CC435 (VA15483)	MSSA; father of patient 7; 2 additional family members clinically affected
7	8	M	Egypt (2 weeks)	Gluteal abscess	—	t435, <i>spa</i> -CC435 (VA15484)	MSSA; son of patient 6
8	34	F	Australia (4 weeks)	Abscesses on chin, left thigh, Bartholin's abscess; later on left ankle	Visit of hotel pool	t105 (VA10403)	MSSA
9	30	F	Dominican Republic (1 week)	Abscess on calf; later on forehead	—	t665, <i>spa</i> -CC012 (VA7169)	MSSA
10	28	F	Nigeria (4 weeks)	Abscesses on both calves	—	t2304 (VA4906)	MSSA; HIV-positive patient
11	37	M	India (3 months)	Abscesses on foot, nose	—	t1308 (VA2677)	MSSA
12	29	M	Pakistan (3 weeks)	Abscesses on calf, right thigh, face; later on both thighs	—	t008 (VA2345)	MRSA
13	34	F	Southeast Asia, Australia (3 months)	Abscesses on both axillae	—	t159, <i>spa</i> -CC435 (VA16335)	MSSA
14	46	F	Costa Rica (4 weeks)	Ulcerative lesions on calf and ankle	Multiple mosquito bites	t791 (VA6317)	MRSA
15	29	F	Thailand (2 weeks)	Abscess on calf	—	t044 (VA13155)	MRSA

*MSSA = methicillin-sensitive *Staphylococcus aureus*; MRSA = methicillin-resistant *Staphylococcus aureus*.

†Note: *spa*-CC was determined by BURP analysis of the local *spa* type database.

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