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Short Communication

Alcaligenes faecalis: an Unusual Cause of Skin and Soft Tissue Infection

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SUMMARY: Skin and soft tissue infection (SSTI) due to *Alcaligenes faecalis* is very rare and has never been studied. The aim of the present study was to investigate the clinical and microbiological characteristics of this infection. We conducted a retrospective review of 5 cases that occurred at our institution over a period of 6 years. All patients had underlying diseases, and infection was secondary to vascular disease or recent surgery in 4 of them. The most common clinical presentations were vascular ulcer infection and surgical site infection. The clinical outcome was uniformly good after treatment, except in 1 patient. In conclusion, *A. faecalis* should be considered a potential pathogen of SSTI, particularly in patients with vascular diseases or after surgery. The history of contact with water or aqueous solutions should be investigated in all cases. The clinical outcome is usually good, but treatment can be difficult in some cases due to the high level of resistance to commonly used antibiotics.

Alcaligenes faecalis is an aerobic nonfermentative, oxidase-positive, nonencapsulated, gram-negative rod (1). It is so named for its ability to produce an alkaline reaction in certain media (2). *A. faecalis* is the most frequently isolated member of family *Alcaligenaceae* in the clinical laboratory. It is present in soil and water as well as human intestinal flora and hospital environments (1). Systemic infection with this organism is very uncommon. It has been reported to cause sporadic cases of endocarditis, meningitis, chronic otitis, pyelonephritis, bacteremia, peritonitis, endophthalmitis, and abscesses (1,3–6). Most infections caused by this organism have been nosocomial and often as a result of the contamination of hospital equipment or fluids and have occurred in immunocompromised hosts (3,4). Recently, an outbreak of nosocomial pseudobacteremia has been reported in a neonatology and pediatric unit (7). Skin and soft tissue infections (SSTIs) due to *A. faecalis* are very rare. Because of the very limited data available, we analyzed the clinical and microbiological characteristics of all cases that occurred at our institution over a period of 6 years.

We conducted a retrospective review of all cases of SSTI caused by *A. faecalis* that occurred at the University Hospital of Guadalajara (Spain), a 400-bed teaching hospital, from January 2008 to December 2013. All strains were isolated from cultures of wound or abscess exudates. The samples were cultured on blood agar, chocolate agar, MacConkey agar, and thioglycollate broth and incubated at 37°C in an atmosphere containing 5% CO_2. In addition, all samples were cultured on Schaedler agar under anaerobic conditions. Identification of the strains was performed using the API 20 NE system (bioMérieux, Marcy l'Etoile, France) and the Vitek II system (bioMérieux) in accordance with reported techniques (8). The antibiotic susceptibility study was conducted using susceptibility cards manufactured by Vitek (bioMérieux), as described previously (8). We reviewed the clinical charts of all cases. We defined SSTI according to previous guidelines (9). *A. faecalis* was judged to be the cause of SSTI if the sample was correctly obtained, gram-negative rods were observed by Gram staining associated with the inflammatory response, the organism was the sole or predominant bacterium isolated, and the patient had clinically significant infection. *A. faecalis* was considered a colonizer if these conditions were not present; these cases were excluded from the study. Infections that occurred more than 72 h after admission of patients who had no evident infection on admission were categorized as nosocomial (10). Postoperative infection was defined as nosocomial if infection was acquired within 30 days after the surgical procedure (11). Response to therapy was defined as disappearance of all signs and symptoms of infection. Attributable mortality was defined as death within 2 weeks of the last positive *A. faecalis* wound culture in the absence of other causes of death.

During the study period, the most frequent pathogen isolated was *Escherichia coli* (33.5%). However, SSTIs caused by *A. faecalis* were very infrequent, as the pathogen was isolated from only 5 patients. The frequency of SSTIs due to *A. faecalis* was 0.082% (proportion of positive cultures). The relevant clinical and microbiological data of all patients are summarized in Table 1. The mean age of our patients was 61.8 years (range, 25–79 years). A summary of the susceptibility testing results for the 5 clinical isolates recovered from our patients is presented in Table 2. To our knowledge, only 1 case of SSTI caused by *A. faecalis* has been previously reported (1). The case involved a patient with a history of diabetes mellitus and microangiopathy who experienced infection of perforating ulcers on the foot (1). The real incidence of SSTI caused by *A. faecalis* is unknown. At our institution, the frequency of SSTIs due to this organism is very low (0.082%). This low number of cases suggests that this organism is either not a common part of the normal human flora or is of low

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Table 1. Characteristics of patients with skin and soft-tissue infections due to *Alcaligenes faecalis*

Case no.	Age/ sex	Underlying disease	Predisposing factor	Clinical presentation	Source of isolate	Mixed infection[1)]	Nosocomial acquired	Antibiotic treatment	Outcome
1	75/M	Chronic anemia, chronic renal failure, COPD, pulmonary fibrosis	Recent surgery (hip fracture)	Surgical wound infection (hip)	Wound exudate	No	Yes	Amoxicillin/ clavulanic acid	Cured
2	25/M	Tinea pedis	Unknown	Bacterial superinfection of tinea pedis (foot)	Skin exudate	No	No	Unknown	Cured
3	79/F	Arterial hypertension, diabetes mellitus, vascular ulcers	Chronic vascular insufficiency	Infection of vascular ulcer (foot)	Ulcer exudate	Yes (*Morganella morganii*)	No	Doxycycline	Recurrence
4	64/M	Arterial hypertension, dyslipidemia, diabetes mellitus, iron deficiency anemia	Chronic ischemia	Infection of vascular ulcer (foot)	Ulcer exudate	Yes (*Staphylococcus aureus*)	No	Unknown	Cured
5	66/M	Arterial hypertension, dyslipidemia, diabetes mellitus, obesity, ischemic heart disease, chronic anemia	Chronic ischemia, recent surgery (finger foot amputation)	Surgical wound infection (finger foot)	Wound exudate	No	No	T/S	Cured

[1)]: In parenthesis: other organisms isolated.
M, male; F, female; COPD, chronic obstructive pulmonary disease; T/S, trimethoprim/sulfamethoxazole.

Table 2. Antibiotic susceptibility of *Alcaligenes faecalis* strains

Antibiotic	Total no. of strains tested	Susceptibility breakpoint (mg/L)	Total no. (%) of strains sensitive	MIC range (mg/L)
Ampicillin	5	≤8	1 (20)	0.25–32
Amoxicillin/clavulanic acid	5	≤8/4	5 (100)	0.25–1
Cefuroxime	5	≤8	0 (0)	32–256
Cefotaxime	5	≤8	3 (60)	0.5–32
Ceftazidime	5	≤8	5 (100)	0.5–1
Imipenem	5	≤4	5 (100)	0.125–0.5
Gentamicin	5	≤4	5 (100)	0.125–0.25
Tobramycin	3	≤4	3 (100)	0.125–0.50
Amikacin	5	≤16	5 (100)	0.125–0.50
Ciprofloxacin	5	≤1	2 (40)	0.50–8
Trimethoprim/sulfamethoxazole	5	≤2/38	4 (80)	0.5–256

virulence. Because of the retrospective nature of our study and the small number of cases, it was difficult to determine the source of infection and the mode of transmission. Infections due to *A. faecalis* are opportunistic, and they are acquired from moist items such as nebulizers, respirators, and lavage fluids (4). For this reason, *A. faecalis* should be suspected in patients with wounds who have a history of contact with water or aqueous solutions. All our patients had underlying diseases. The presence of vascular diseases or recent surgery predisposed patients to the development of infection. Similar findings have been found for SSTIs caused by other similar nonfermentative gram-negative rods such as *Achromobacter xylosoxidans* (12). Most cases were community-acquired, but infection also can be nosocomial, particularly after surgery. The clinical manifestations do not differ significantly from those caused by other organisms. However, 2 patients experienced surgical wound infections, and to our knowledge, *A. faecalis* has not been previously associated with these infections in the literature.

Identification of *A. faecalis* can be performed using traditional phenotypic tests and commercial systems. It is easy to discriminate *A. faecalis* from other more frequent organisms such as *E. coli* and other *Enterobacteriaceae* because *A. faecalis* is a nonfermentative, oxidase-positive, gram-negative rod. Treatment of infections caused by *A. faecalis* is often difficult because of the high level of antibiotic resistance. As noted in previous studies (13), most of our isolates were resistant to ampicillin, cefuroxime, cefotaxime, and ciprofloxacin. Strains with high-level resistance due to extended spectrum β-lactamases have been reported in clinical isolates (14,15). Recently, carbapenem resistance due to VIM metallo-β-lactamase has been described in India (16). The fact that these organisms can be resistant to commonly used antibiotics such as cefuroxime, cefotaxime, and ciprofloxacin emphasizes the importance of performing sensitivity testing. Currently, carbapenems, antipseudomonal penicillins, and trimethoprim/sulfamethoxazole are considered the agents of choice for the treatment of *A. faecalis* infections (3). Although the number of cases in our study was very small, all strains were susceptible to amoxicillin/clavulanic acid. This antibiotic might be a good option for treating SSTIs caused by *A. faecalis*. However, the optimal therapeutic

regimen remains unclear because of the limited data. Further studies should be performed to focus on optimal therapeutic regimens for treating these infections.

In conclusion, this paper aimed to alert clinicians of the involvement of *A. faecalis* in SSTIs. This organism should be considered a potential pathogen, particularly in patients with vascular diseases or after surgery. The history of contact with water or aqueous solutions should be investigated in all cases. The clinical outcome is usually good, but treatment can be difficult in some cases because of the high level of resistance to commonly used antibiotics.

Conflict of interest None to declare.

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