Advance Publication by J-STAGE

Japanese of Journal of Infectious Diseases

*Alcaligenes faecalis*: an unusual cause of skin and soft tissue infection

Daniel Tena, Cristina Fernández, and María R. Lago

Received: April 22, 2014. Accepted: July 3, 2014
Published online: November 25, 2014
DOI: 10.7883/yoken.JJID.2014.164

Advance Publication articles have been accepted by JJID but have not been copyedited or formatted for publication.
Alcaligenes faecalis: an unusual cause of skin and soft tissue infection

Authors: Daniel Tena, Cristina Fernández, María R. Lago

Sección de Microbiología. Hospital Universitario de Guadalajara. Guadalajara, Spain.

Running title: Skin and soft-tissue infection caused by Alcaligenes faecalis

Corresponding author: Dr. Daniel Tena. Sección de Microbiología. Hospital Universitario de Guadalajara. C/. Donantes de sangre s/n. 19002 Guadalajara. Spain. Phone: +34-949-209236. Fax: +34-949-209213. E-mail: danielt@sescam.jccm.es

ABSTRACT

Skin and soft tissue infections (SSTIs) due to Alcaligenes faecalis are very rare and never have been studied. The aim of the present study was to investigate the clinical and microbiological characteristics of this infection. We carried out a retrospective review of 5 cases that occurred at our area over a period of 6 years. All patients had underlying diseases and the infection was secondary to vascular disease or recent surgery in 4 of them. The most common clinical presentation was infection of vascular ulcer and surgical site infection. The clinical outcome was uniformly good after treatment except in one patient. In conclusion, A. faecalis should be considered a potential pathogen of SSTI, especially 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.

Keywords: Alcaligenes faecalis; skin infection: wound infection
*Alcaligenes faecalis* is an aerobic non-fermentative, 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 environment (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 often related to contamination of hospital equipment or fluids, and have occurred in immunocompromised hosts (3,4). Recently, an outbreak of nosocomial pseudobacteremia in a neonatology and paediatric unit has been reported (7). Skin and soft-tissue infections (SSTIs) due to *A. faecalis* are very rare. Because of the very limited data available, we analysed the clinical and microbiological characteristics of all cases that occurred in our area over a period of 6 years.

We carried out 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, McConkey agar and thioglycollate broth and incubated at 37ºC in an atmosphere containing 5% CO₂. In addition, all samples were cultured on Schaedler agar under anaerobic conditions. Identification of the strains was performed by the API 20 NE system (bioMérieux, Marcy l’Etoile, France) and the Vitek II system (bioMérieux Marcy l’Etoile, France) in accordance with reported techniques (8). The antibiotic susceptibility study was done using susceptibility cards by Vitek (bioMérieux, Marcy l’Etoile, France), 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 a 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 hours after admission in patients who had no evident infection on admission were categorized as nosocomial (10). A postoperative infection was defined as nosocomial if the infection was acquired within 30 days after the surgical procedure (11). A 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. *A. faecalis* was isolated from 5 patients.

The frequency of SSTIs due to *A. faecalis* was 0.082% (proportion of positive cultures). Clinical and microbiological relevant data of all cases are summarized in table 1. The mean age of our patients was 61.8 years (range, 25 to 79 years). A summary of susceptibility testing results for the 5 clinical isolates recovered from our patients is presented in table 2. To our knowledge, only one case of SSTI caused by *A. faecalis* has been previously reported (1). It was a patient with a history of diabetes mellitus and microangiopathy who suffered an infection of perforating ulcers on the foot (1). The real incidence of SSTI caused by *A. faecalis* is unknown. In our area, the frequency of SSTIs due to this organism was 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 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 are acquired from moist items as nebulizers, respirators and lavage fluids (4). For this reason, *A. faecalis* should be suspected in patients with wounds that 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 to the development of the infection. Similar findings have been found in SSTIs caused by other similar non-fermentative Gram-negative rods such as *Achromobacter xylooxidans*.
(12). Most cases were community-acquired but the infection also can be nosocomial, especially after surgery. The clinical manifestations do not differ significantly from those due to other organisms. However, two patients suffered 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 non-fermentative, oxidase-positive, Gram-negative rod. Treatment of infections caused by *A. faecalis* is often difficult due to the high level of antibiotic resistance. As 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 beta-lactamases have been reported in clinical isolates (14,15). Recently, carbapenem resistance due to VIM metallo-beta-lactamase has been described in India (16). The fact that these organisms can be resistant to commonly used antibiotics such as cefuroxime, cefotaxime or ciprofloxacin, emphasizes the importance of including sensitivity testing. Currently, carbapenems, antipseudomonal penicillins and trimethoprim-sulfamethoxazole are considered the agents of choice for treatment of *A. faecalis* infections (3). Although the number of cases in our study is very small, all strains were susceptible to amoxicillin/clavulanic acid. This antibiotic might be a good option for treatment of 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 aims to alert clinicians of the involvement of *A. faecalis* in SSTIs. This organism should be considered a potential pathogen, especially 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.
Declaration of interest

The authors report no conflicts of interest.

REFERENCES


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

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

**Note.** M: male; F: female; COPD: chronic obstructive pulmonary disease; T/S: trimethoprim-sulfamethoxazole. 
\(^1\)In parenthesis: other organisms isolated.
Table 2. Antibiotic susceptibility of *Alcaligenes faecalis* strains

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Total no. of strains tested</th>
<th>Susceptibility breakpoints (mg/L)</th>
<th>Total no. of strains sensitive</th>
<th>MIC range of the strains (mg/L)</th>
<th>Percentage of strains sensitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampicillin</td>
<td>5</td>
<td>≤ 8</td>
<td>1</td>
<td>0.25-32</td>
<td>20 %</td>
</tr>
<tr>
<td>Amoxicillin/clavulanic acid</td>
<td>5</td>
<td>≤ 8/4</td>
<td>5</td>
<td>0.25-1</td>
<td>100 %</td>
</tr>
<tr>
<td>Cefuroxime</td>
<td>5</td>
<td>≤ 8</td>
<td>0</td>
<td>32-256</td>
<td>0 %</td>
</tr>
<tr>
<td>Cefotaxime</td>
<td>5</td>
<td>≤ 8</td>
<td>3</td>
<td>0.5-32</td>
<td>60 %</td>
</tr>
<tr>
<td>Ceftazidime</td>
<td>5</td>
<td>≤ 8</td>
<td>5</td>
<td>0.5-1</td>
<td>100 %</td>
</tr>
<tr>
<td>Imipenem</td>
<td>5</td>
<td>≤ 4</td>
<td>5</td>
<td>0.125-0.5</td>
<td>100 %</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>5</td>
<td>≤ 4</td>
<td>5</td>
<td>0.125-0.25</td>
<td>100 %</td>
</tr>
<tr>
<td>Tobramycin</td>
<td>3</td>
<td>≤ 4</td>
<td>3</td>
<td>0.125-0.50</td>
<td>100 %</td>
</tr>
<tr>
<td>Amikacin</td>
<td>5</td>
<td>≤ 16</td>
<td>5</td>
<td>0.125-0.50</td>
<td>100 %</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>5</td>
<td>≤ 1</td>
<td>2</td>
<td>0.50-8</td>
<td>40 %</td>
</tr>
<tr>
<td>Trimethoprim-sulfamethoxazole</td>
<td>5</td>
<td>≤ 2/38</td>
<td>4</td>
<td>0.5-256</td>
<td>80 %</td>
</tr>
</tbody>
</table>