Alcaligenes xylosoxidans Cholecystitis and Meningitis Acquired during Bathing Procedures in a Burn Unit: A Case Report

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Alcaligenes xylosoxidans, a nonfermentative, Gram-negative rod often found in aqueous environments, has been isolated from respirators, incubators, and disinfectant solutions in the hospital environment. It is known to cause disease in immunocompromised (eg, burn) patients and represents a cross-contamination risk related to wound care. In the authors’ burn unit, two patients, admitted with deep dermal burns during a 1-month time period, acquired serious A. xylosoxidans infections. The first involved A. xylosoxidans-associated cholecystitis in an adult with 32% total body surface area (TBSA) burns and the second involved A. xylosoxidans meningitis in an adult with 30% TBSA burns. Both patients received hydrotherapy (bathing) in the same bathing tub, one patient after the other. Culture from environmental sources isolated A. xylosoxidans from the bathing mattress. Bacterial analysis of the isolates, including antimicrobial susceptibility testing and pulsed-field gel electrophoresis, suggested the patients had been infected by the same strain — ie, cross-contaminated — probably during treatment of their burns. The isolated strains were resistant not only to broad-spectrum penicillins and cephalosporins, but also to imipenem, to which past A. xylosoxidans strains have been susceptible. These findings underscore the need for strict infection control to prevent cross-contamination and disease outbreak.

KEYWORDS: burn wounds, Alcaligenes xylosoxidans, bathing, burns unit, cross-contamination

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In the hospital environment, Alcaligenes xylosoxidans has been isolated from respirators, incubators, and disinfectant solutions. A. xylosoxidans infection is thought to occur mostly in immunocompromised patients and those with severe underlying disease conditions. The majority of A. xylosoxidans strains are multidrug-resistant; thus, strict infection control is required to prevent spread of disease. Two cases (one unusual because of the rarity of A. xylosoxidans-related cholecystitis) occurred within a 1-month period in patients who had sustained severe burns and had been treated in the burn unit of the authors’ facility.

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**Case Reports**

**Case 1.** Mr. B, a 78-year-old man, sustained flame burns when his trousers accidentally caught fire in May 2007. He was immediately taken to the authors’ burn unit. On initial examination, it was noted that Mr. B had sustained deep burn (DB) to both lower legs, comprising 8% of the total body surface area (BSA); deep dermal burn (DDB) to both thighs, comprising 14% of the total BSA; and superficial dermal burn (SDB) to both forearms and the face, comprising 10% of the total BSA (see Figure 1). A decompression incision was made in both lower legs. The next day, all DB and DDB tissue was surgically removed from the legs and skin grafting was performed. Seven days after surgery, Mr. B underwent hydrotherapy in a hospital bathing tub — 10 days later, he developed a high fever and severe infection in both lower legs. Below-the-knee amputation was performed emergently for both legs due to life-threatening sepsis. Mr. B’s general condition improved over the next 2 weeks and he underwent bathing treatment every other day. Forty days after the injury, *A. xylosoxidans* was isolated from the residual wound, prompting immediate culture of environmental surfaces. *A. xylosoxidans* was isolated from the bathing mattress (see Figure 2). Clinical systemic and local inflammatory symptoms were not observed and the entire wound was resurfaced with free skin grafting.

Mr. B was discharged from the burn unit 10 weeks after admission but 1 week later, he developed a temperature of 39.1°C and stomach pain. An abdominal CT scan detected a swollen gallbladder and expanded bile duct (see Figure 3). Hematological studies revealed a white blood cell (WBC) count of 11.9×10⁹/L and increases in C-reactive protein (CRP) (9.9 mg/dL), alkaline phosphatase (485 IU/L), and gamma-glutamyl transpeptidase (87 IU/L) levels, indicating severe inflammation of the gallbladder (cholecystitis). Percutaneous transhepatic biliary drainage was performed and the remaining bile was drained continuously though a drainage tube. *A. xylosoxidans* was isolated from the bile and treatment with imipenem was initiated but subsequently changed to tazobactam/piperacillin following the results of antimicrobial susceptibility testing. Mr. B’s general condition improved over the next 2 weeks and he underwent bathing treatment every other day.

**Figure 1.** Case 1: Burn area and depth.

**Figure 2.** Picture of bathing set up for hydrotherapy. *A. xylosoxidans* was isolated from an area of the bathing mattress within the dotted circle.

**Figure 3.** Abdominal CT scan showing a swollen gallbladder.

**KEY POINTS**

- The authors describe two burn patients who developed serious infections, including cholecystitis and meningitis, following hydrotherapy.
- Culture results confirmed the presence of *Alcaligenes xylosoxidans* in the wound, spinal fluid, and bile of the patients and on the surface of the bathing mattress.
- The severity of the reported infections and resistance of isolates to previously effective antibiotics underscores the importance of strict infection control practices.
improved over the next 3 weeks and he was discharged 3 months after the injury.

**Case 2.** At the end of May 2007, 66-year-old Ms. K sustained scald burns when she accidentally fell over a bowl filled with boiling water. She was taken immediately to the authors’ emergency unit. On initial examination, Ms. K had sustained DDB to the back and right upper arm, comprising 20% of the total BSA; and SDB to both thighs, comprising 10% of the total BSA (see Figure 4). Initial surgery was performed the next day to remove all DDB tissue on the back along with free skin grafting. Seven days after surgery, Ms. K received hydrotherapy in the hospital’s bathing tub. Her general condition improved and she was discharged from the burn unit 2 weeks after the injury. The entire wound was resurfaced 10 weeks after the injury with another free skin graft.

However, 12 weeks after the injury, the patient developed a mental disorder (agitated and compromised ability to communicate) with a fever of 38.8°C and a slight headache. A CT scan detected a swollen ventricle (see Figure 5). Hematological studies revealed a WBC count of 13.3 × 10^9/L, and an increased CRP level (2.9 mg/dL), indicating bacterial meningitis. Ventricular drainage was performed, and *A. xylosoxidans* was isolated from the cerebrospinal fluid (CSF). Treatment with amikacin and ceftazidime was initiated and subsequently changed to tazobactam/ piperacillin and cef tazidime after antimicrobial susceptibility testing. Four weeks later, recognizing the absence of *A. xylosoxidans* in the CSF, a ventriculo-peritoneal shunt was inserted. Ms. K’s general condition improved and she was discharged 5 months after the injury.

Figure 6 shows the clinical course of both patients.

**Bacterial Isolate Analysis**

Three isolates of *A. xylosoxidans*, including those from the wound and bile of case 1, the CSF of case 2, and environmental sources, were subjected to antimicrobial susceptibility testing and pulsed-field gel electrophoresis (PFGE) and the results were found to be similar (see Table 1 and Figure 7).
isolates were resistant to almost all antibiotics, including ceftriaxone, cefpodoxime proxetil, cefepime, cefozopran, flomoxef sodium, imipenem, meropenem, aztreonam, entamicin, tobramycin, amikacin, minocycline, and ciprofloxacin; the only antibiotics to which all isolates were uniformly susceptible was tazobactam/pippracillin.

Three isolates from the environmental sources — the CSF of case 2 and the bile of case 1 — were subjected to PFGE of Xba I-genomic DNA to determine their clonal homology (see Figure 7). The PFGE fingerprints of two isolates (Lane 1, environmental sources; and Lane 3, bile of case 1) showed identical patterns. Also, their PFGE fingerprints were closely related to that of Lane 2 (CSF of case 2).

**Discussion**

*A. xylosoxidans* is a nonfermentative, Gram-negative rod often isolated from aqueous environments and known to cause disease in immunocompromised patients. Little has been reported about its pathogenicity in humans, except in cases involving children.2,5 Reports of CSF infection by *A. xylosoxidans* are even rarer.6 In case studies, Kumar et al4 reported that two strains of *A. xylosoxidans* were isolated from CSF, Boukadida et al7 documented a case of *A. xylosoxidans*-associated neonatal meningitis transmitted by aqueous eosin, and D’Amato et al8 reported a case of *A. xylosoxidans* meningitis related to a gunshot wound. No case reports describing cholecystitis due to *A. xylosoxidans* were found in the literature.

Burn wound infection is common and difficult to control because cutaneous surfaces are without protective barriers; thus, burn patients may easily acquire bacterial infection, including *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Legionella pneumophila*, *Aerobacter aerogenes*, *Proteus vulgaris*, and *A. xylosoxidans*.9–11 Several investigators have reported *A. xylosoxidans* in patients with underlying diseases, including malignancies, cardiac disease, and

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**Figure 6.** Clinical course of patients. ABPC/STB = ampicillin/subbaactam; PIPC = pippracillin; TEIC = teicoplanin; CPFX = ciprofloxacin; IPM/CS = imipenem/cilastatin; TAZ/PIPC = tazobactam/pippracillin; MEPM = meropenem; CLDM = clindamycin; AMK = amikacin; CAZ = ceftazidime; ICU = intensive care unit
immunosuppression. Burn patients also have a high risk of infection because severe burns lead to a compromised immune system, which may cause life-threatening general infections, including sepsis, meningitis, and cholecystitis from common burn wound infections. The results of the susceptibility tests and PFGE patterns of all isolates were similar, suggesting that both patients acquired the organism due to cross-contamination of the same strains of *A. xylosoxidans* from the hospital environment — specifically, from the bathing mattress.

Results of *in vitro* susceptibility studies of the isolates have found that *A. xylosoxidans* is a multidrug-resistant organism. Legrand et al. studied susceptibility in 26 blood cultures from 10 patients with *A. xylosoxidans* infections between 1983 and 1988 and reported that the isolates were susceptible to trimethoprim-sulfamethoxazole, as well as the antipseudomonal penicillins, ceftazidime, cefoperazone, and imipenem. In 1996, Duggan et al. performed susceptibility studies in 11 cases of *A. xylosoxidans* bacteremia and found that all were susceptible to broad-spectrum penicillins, imipenem, ceftazidime, and trimethoprim-sulfamethoxazole. Aisenberg et al. investigated 46 patients with hematogenous *A. xylosoxidans* infection between 1989 and 2003, reporting that most isolates exhibited susceptibility to carbapenems, antipseudomonal penicillins, and trimethoprim-sulfamethoxazole. In 2003, Gomem-Cerezo et al. reviewed 44 cases of *A. xylosoxidans* bacteremia diagnosed over a 10-year period and concluded that antibiotic therapy with antipseudomonal penicillins or carbapenems would be a reasonable choice. Based on the authors’ review of current drug-susceptibility data, *A. xylosoxidans* appears to have become resistant to novel antibiotics to varying degrees, reducing the number of effective antimicrobial agents. Antipseudomonal penicillins and carbapenems have maintained their effectiveness against the organism until recently. However, strains of *A. xylosoxidans* isolated from the authors’ patients were found to be resistant not only to almost all antibiotics, including broad-spectrum penicillins and cephalosporins, but also to imipenem, to which past *A. xylosoxidans* strains were susceptible. Only tazobactam/pipracillin maintained their effectiveness against strains of *A. xylosoxidans*.

### TABLE 1

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*Figure 7.* Pulsed-field gel electrophoresis banding patterns of XbaI-genomic DNA from three isolates of *A. xylosoxidans*. Lane 1, environmental sources; Lane 2, Case 2 CSF; Lane 3, Case 1 bile.
Achromobacter xylosoxidans isolated from the authors’ patients and could improve their conditions.

**Conclusion**

From the authors’ experience, including the two case studies presented, as well as information in the literature, *A. xylosoxidans* isolates should be considered as a possible etiology of infection in patients with extensive burn injuries. Various isolates were found to be multidrug-resistant but tazobactam/piperacillin still appear to be effective against the organism. Strict infection control practices are required to prevent cross-contamination and disease outbreaks in acute care facilities because, in addition to the case reported here, the organism has been cultured from several aqueous environments and needs to be monitored.

**References**