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CASE REPORT

Shewanella soft tissue infection: case report and literature review

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Summary
Objective: To better understand the clinical characteristics of soft tissue infections caused by *Shewanella* in humans.
Methods: We report a case of *Shewanella* soft tissue infection and review the English literature from a search of PubMed.
Results: A total of 27 adults (mean age 61.1 ± 16.0 years) with soft tissue infections caused by *Shewanella* were included for analysis. Limb involvement was found in 22 (81.5%) patients, while scalp, face, perineum, lacrimal sac, and abdominal wall involvement were each found in one patient. Chronic ulcer over the leg (14 cases (51.9%)), steroid use (four cases (14.8%)), and liver cirrhosis (three cases (11.1%)) were the major underlying conditions. *Shewanella* bacteremia was found in 14 out of 22 patients with soft tissue infections involving the limbs. Two patients died of septicemia, giving a mortality rate of 7.4%.
Conclusions: *Shewanella* soft tissue infections usually develop in immunocompromised patients with a preexisting cutaneous ulcer (particularly over the legs) after marine environment or seawater exposure. In view of the possible catastrophic consequences, education on the prevention of *Shewanella* soft tissue infections in at-risk people (e.g., the immunocompromised or elderly with a cutaneous ulcer) relating the need to avoid exposure to the marine environment or seawater may be of importance.

Introduction

Shewanella spp are motile Gram-negative bacilli with the major phenotypic characteristic of production of large

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amounts of hydrogen sulfide (H_2S) in the butt of triple sugar iron agar.[1] *Shewanella algae* and *Shewanella putrefaciens* are frequently found in non-human sources such as the marine environment and foodstuffs, yet are opportunistically pathogenic for humans.[1]

S. putrefaciens was once believed to be the major human pathogenic species in the genus *Shewanella*, and authors in most of the earlier reports on *Shewanella* human infections attributed the etiology to *S. putrefaciens*.[2] The taxon *S. alga* was previously considered one biogroup of the genetically heterogeneous *S. putrefaciens* species.[3] In 1990, *S. alga* was first recovered from red algae and was proposed to be a tetrodotoxin-producing microbe.[4] A subsequent study disclosed that the high G+C content in the previously recognized *S. putrefaciens* isolates were genetically related to *S. alga*, and most of the clinical *S. putrefaciens* isolates should therefore be reclassified as *S. alga*.[5] In 1997, *S. alga* was renamed *S. algae*.[6] It is likely that >80% of clinical *Shewanella* isolates in human infections are *S. algae*.[2]

Although *S. algae* was recognized as a new species in 1992,[5] misidentification of *S. algae* as *S. putrefaciens* has persisted ever since. These misidentifications have resulted from the failure of both conventional phenotypic characteristic testing and commercialized bacterial identification systems (e.g., ID 32 GN, and VITEK) in differentiating *S. putrefaciens* from *S. algae*. In humans, soft tissue infections are mostly encountered among infections reported to be caused by *Shewanella* species.[2] To better understand clinical characteristics of soft tissue infections caused by *Shewanella* in humans, we report a case of severe soft tissue infection caused by *S. algae* in an immunocompromised adult and review the literature.

Case report

A 42-year-old man with an underlying hepatitis B-related liver cirrhosis was hospitalized because of fever and a swollen left leg. He had injured his left leg 2 days earlier when he was handling a seawater fish in preparation for his dinner. Some skin lesions developed when his leg was stuck by the spinous dorsal fin of the fish, and he tried to clean the oozing blood from the damaged skin by flushing it with the water in which the fish had been immersed before. Local heat and swelling over his left leg soon developed, followed by fever and rigors. Upon admission, he was acutely ill; his body temperature was 39.8 °C, and blood pressure was 90/60 mmHg. Physical examination revealed an extremely swollen left leg with edematous dark red to purple-colored skin, and some hemorrhagic bullae on the soft tissue over the distal end of the left leg and the left ankle joint.

Blood tests revealed that his peripheral leukocyte count was 2.7×10^9/l (normal 3.9—10.6×10^9/l) with the presence of band-form cells and metamyelocytes, and his platelet count was 37×10^9/l (normal 150—400×10^9/l). C-reactive protein was 70.1 mg/l (normal <5 mg/l), aspartate aminotransferase was 146 (normal <37 U/l), alanine aminotransferase was 55 U/l (normal <40 U/l), and serum creatinine was 1.8 mg/dl (normal 0.4—1.4 mg/dl). A computed tomography revealed severe edematous changes of the subcutaneous tissue and muscles in the left leg. Under the impression of necrotizing fasciitis and septic shock, parenteral ceftriaxone (2 g/day) and oral doxycycline (200 mg/day) were empirically administered after sampling blood for culture, and an emergency operation was performed. The surgical procedure included fasciotomy and extensive debridement of the devitalized soft tissue along the lateral side of the tibialis anterior of the affected leg, from the level below the knee joint to the ankle joint. The excised devitalized soft tissue disclosed suppurative necrosis on histopathology. The administered antibiotics were switched to ciprofloxacin (1200 mg/day parenterally).

Although it was hemodynamically stable after surgery, his left leg did not make a favorable clinical response. The non-excised skin and muscles around the surgical site of his left leg were poorly perfused. On day 4 of hospitalization, cultures of blood and excised necrotic tissue sampled during the operation both yielded Gram-negative rods, which were identified as *S. putrefaciens* by ID 32 GN (bioMérieux Vitek, Inc., Hazelwood, MO, USA). Susceptibility testing using VITEK I automated system (bioMérieux Vitek, Inc.) indicated that the isolated microbe was susceptible to aztreonam, ampicillin/sulbactam, piperacillin/tazobactam, ceftazidime, ceftriaxone, ciprofloxacin, levofloxacin, imipenem, gentamicin, and amikacin. To definitively identify the isolated pathogen, the partial *16S rRNA* gene was sequenced by PCR amplification using a universal forward primer 27F (5′-AGAGTTTGATCCTGGCTCAG-3′)[7] and a universal reverse primer 907R (5′-CCGTCAATTCCTTTGAGTTT-3′),[8] as previously described.[7,8] Two harvested DNA each with 881 and 895 nucleotides were sequenced by 310 Genetic Analyzer (Applied Biosystems) and were compared to those available in the GenBank database (http://www.ncbi.nlm.nih.gov/BLAST/BLAST.cgi); they were found to be a 100% match with those of *S. algae*.

With regards to susceptibility, Etest on this *S. algae* isolate was performed in accordance with the instructions of the manufacturer (AB Biodisk, Solna, Sweden). The selected antimicrobials (minimum inhibitory concentrations (MICs) in μg/ml) were as follows: cephalothin (>256), cefotaxime (0.19), ceftriaxone (0.25), ceftazidime (0.25), cefepime (0.047), ciprofloxacin (0.19), levofloxacin (0.25), ampicillin/sulbactam (0.75), piperacillin/tazobactam (0.125), ertapenem (0.38), imipenem (6), and meropenem (0.38). Ciprofloxacin was continued because of its favorable MIC.

In spite of antimicrobial use, progressive clinical deterioration was observed. The patient received two further debridement procedures in the affected leg, and as a result, a considerable portion of skin and muscles in his left leg was excised. All the excised tissues were suppuratively necrotic by histopathology. Because of persistent deterioration, his left leg was amputated from the level of above-knee joint on hospitalization day 16. Thereafter his course was uneventful, and the patient was discharged on day 31.

PubMed search and literature review

We performed a PubMed search for reports on *Shewanella* infections that have been published since 1966 using the keywords '*Shewanella algae*', '*Shewanella alga*', '*Shewanella putrefaciens*' and '*Pseudomonas putrefaciens*' (the previous name for *Shewanella putrefaciens*), and limited the search to the English literature and adult humans. A total of 27 adults (mean age 61.1 ± 16.0 years) with soft tissue infections caused by *S. algae*, *S. alga*, *S. putrefaciens* or *P. putrefaciens* were found.[9—27] Demographic, clinical, and

Table 1 Demographic, clinical, and laboratory characteristics of human soft tissue infections caused by *Shewanella* species[a]

No./sex/age (y) Reference	Underlying disease/condition	Bacteria (source) (Method of identification)	Affected site	Prescribed antibiotic(s) ± debridement	Seawater exposure
1/F/82 9, 10[b]	Malnutrition, leg edema and ulcers	*Pseudomonas putrefaciens*, CoNS (wound) (Conventional method)	Both legs	Co-trimoxazole	Unknown
2/F/73 11	Anemia, renal failure, bilateral leg ulcers	*Pseudomonas putrefaciens* (blood and wound), *Pseudomonas aeruginosa*, *Staphylococcus aureus* (wound) (Conventional method)	Both legs ulcers	Ampicillin, gentamicin	Unknown
3/F/60 12	Congestive heart failure, leprosy	*Pseudomonas putrefaciens*, *Escherichia coli*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Moraxella spp* (wound) (Unknown)	Left wrist, left leg	Co-trimoxazole	Unknown
4/M/63 13	Leg ulcers, congestive heart failure, alcoholic liver cirrhosis, gouty arthritis	*Pseudomonas putrefaciens* (blood/wound), CoNS, *Enterobacter agglomerans*, *Pseudomonas fluorescens* (wound) (API 20E[c])	Chronic ulcers on legs	Gentamicin, chloramphenicol; co-trimoxazole, debridement	Unknown
5/F/67 14	Hypothyroidism, hypertension, stasis ulcers of both legs, right arm edema and ecchymosis	*Pseudomonas putrefaciens*, group A streptococcus (blood) (API 20E)	Both legs	Nafcillin, penicillin, gentamicin	No
6/F/34 15	Laurence—Moon—Bardet—Biedl syndrome, renal failure on dialysis, retinal pigmentation, blindness, hypogonadism, obesity	*Pseudomonas putrefaciens* (blood) (Conventional method, API Rapid NFT system[c])	Both legs	Mezlocillin, gentamicin	Unknown
7/M/39 15	Prosthetic aortic valve infective endocarditis, chronic leg edema	*Pseudomonas putrefaciens*, group G streptococci (blood) (API 20E)	Left leg	Ceftazidime	Yes
8/M/75 16	Chronic angina, left leg edema secondary to saphenous vein harvest	*Pseudomonas putrefaciens* (blood) (VITEK[c])	Left leg	Piperacillin, ampicillin	Yes
9/M/68 17	COPD, venous stasis, steroid use	*Shewanella putrefaciens* (blister aspirates) (API 20NE[c])	Left ankle ulcer	Flucloxacillin, penicillin, cefotaxime, vancomycin	No
10/NA/75 18	Diabetic leg ulcer	*Shewanella putrefaciens* (blood) (API 20NE)	Leg ulcer	NA	Unknown
11/NA/57 18	Traumatic ulcer of lower extremity, tetanus	*Shewanella putrefaciens* (blood) (API 20NE)	Leg ulcer	NA	Unknown
12/NA/36 18	Traumatic ulcer of lower extremity, cellulitis	*Shewanella putrefaciens*, *Serratia marcescens* (blood) (API 20NE)	Leg ulcer	NA	Unknown
13/F/80 19	Rheumatoid arthritis, diabetes, arterial insufficiency of the legs, leg ulcers	*Shewanella alga* (blood) (Conventional method)	Left leg	Ampicillin and gentamicin	Unknown
14/M/69 19	Congestive heart failure, right leg ulcers	*Shewanella alga* (blood/wound) (Conventional method)	Right leg	Penicillin and gentamicin; ampicillin and gentamicin; cefuroxime and gentamicin; cefuroxime (oral), surgery	Unknown

Table 1 (*Continued*)

No./sex/age (y) Reference	Underlying disease/condition	Bacteria (source) (Method of identification)	Affected site	Prescribed antibiotic(s) ± debridement	Seawater exposure
15/M/69 [20]	Chronic cholecystitis, cholelithiasis	*Shewanella putrefaciens*, *Escherichia coli* (pus) (ID 32 GN[c])	Abdominal wall infections and abscess	Ceftazidime and gentamicin; cephalexin	Unknown
16/F/53 [20]	Aplastic anemia, steroid use, fish puncture wound (finger)	*Shewanella putrefaciens*, *Staphylococcus aureus*, viridans streptococci (pus) (ID 32 GN)	Right middle finger	Piperacillin and vancomycin	Unknown
17/M/71 [20]	Obstructed nasolacrimal duct	*Shewanella putrefaciens*, *Pseudomonas aeruginosa* (pus) (ID 32 GN)	Dacryocystitis	Cephalexin, drainage	Unknown
18/M/53 [20]	Rectal cancer, intra-abdominal carcinomatosis	*Shewanella putrefaciens* (pus) (ID 32 GN)	Perineal abscess	Ceftazidime and gentamicin	Unknown
19/M/73 [20]	Alcoholism, fatty liver	*Shewanella putrefaciens* (blood/wound) (ID 32 GN)	Periorbital area	Cefotaxime, clindamycin and gentamicin	Unknown
20/M/61 [21]	COPD, vascular insufficiency of the lower extremities	*Shewanella putrefaciens* (wound) (VITEK)	Right foot abscess	Ceftriaxone and clindamycin, co-trimoxazole (oral), I/D	No
21/M/67 [22]	SLE, asthma, steroid use, chronic leg ulcers	*Shewanella putrefaciens* (wound) (API 20NE)	Left leg	Penicillin and gentamicin, ciprofloxacin (oral)	Yes
22/M/36 [23]	Healthy	*Shewanella putrefaciens*, *Staphylococcus aureus*, *Enterococcus faecalis* (wound) (Unknown)	Both hands	Flucloxacillin, ceftriaxone	Yes
23/M/66 [24]	Multiple myeloma, renal insufficiency	*Shewanella alga* (blood) (API 20NE and GNI[c])	Both forearms	Ceftazidime, amikacin	No
24/M/87 [25]	Cushingoid appearance	*Shewanella putrefaciens* (blood) (VITEK II[3] and ID 32 GN)	Left forearm	Ampicillin/sulbactam, ampicillin (oral)	Yes
25/M/27 [26]	Healthy	*Shewanella putrefaciens* (wound) (ID 32 GN)	Scalp	Ciprofloxacin, debridement	Yes
26/F/67 [27]	Chronic renal failure on maintenance hemodialysis	*Shewanella putrefaciens* (wound) (VITEK, BBL Crystal[c])	Left thigh	Ceftazidime, minocycline, oxacillin, fasciotomy, debridement	No
27/M/42 Current case	Liver cirrhosis, hepatitis B	*Shewanella algae* (blood/wound) (Identification of 16S rDNA sequence)	Left leg	Ciprofloxacin, debridement	Yes

M, male; F, female; CoNS, coagulase-negative staphylococci; COPD, chronic obstructive pulmonary disease; SLE, systemic lupus erythematosus; NA, not available.
All patients survived except for patient cases 5 and 19 who died of sepsis and patient case 18 who died of underlying diseases.
[a] *Pseudomonas putrefaciens* is the previous name for *Shewanella putrefaciens* and *Shewanella alga* is the previous name for *Shewanella algae*.
[b] Case No. 1 was separately reported in two different articles.
[c] ID 32 GN, API 20E, API 20NE, VITEK, VITEK II, API Rapid NFT system, GNI, and BBL Crystal are commercial devices, which were used manually, semi-automatically, or automatically for the identification of bacteria.

laboratory information for these patients are summarized in Table 1.

Of the 27 patients with soft tissue infections, limb involvement (18 lower and four upper limbs) was found in 22 (81.5%), while scalp, face, perineum, lacrimal sac, and abdominal wall involvement were each found in one patient. With regard to the leading underlying diseases/conditions, chronic ulcer over the leg (14 cases (51.9%)) resulting from a variety of causes including venous stasis, arterial insufficiency, diabetic foot, chronic leg edema, or traumatic wounds was most commonly found, followed by steroid use (four cases (14.8%)) and liver cirrhosis (three cases (11.1%)). *Shewanella* bacteremia was found in 14 of the 22 patients with soft tissue infections involving the limbs (11 cases of monomicrobial bacteremia and three of polymicrobial bacteremia), and in one of the five cases of soft tissue infection involving other anatomic sites. Overall, two patients died of septicemia, giving a mortality rate of 7.4%.

Discussion

Out of more than 30 already known *Shewanella* species, only *S. putrefaciens* and *S. algae* are considered pathogenic for humans.[2] The reason why *S. algae* causes more infections in humans than *S. putrefaciens* is not fully understood. Some investigators have hypothesized that the bacterial hemolysin produced by the culprit *S. algae* plays an important role in the pathogenesis of human infection.[17]

Remarkably, in addition to a variety of immunocompromising conditions, a preexisting chronic ulcer over the lower limb was found in more than 50% of the affected patients. Because *Shewanella* species normally exist in the marine environment, the cutaneous breaches on the legs of these immunocompromised patients served as a portal of entry for the opportunistic pathogens during their recreational activities.

Unlike the previously reported cases of *Shewanella* soft tissue infections, our case was clinically fulminant and resembled the rapidly progressive soft tissue infections caused by *Vibrio vulnificus*[28] and *Aeromonas* species,[29] which are characterized by the emergence of bullae and rapid development of progressive necrotizing fasciitis and septic shock. The clinical manifestations of this case suggest that when it comes to the etiology for a severe soft tissue infection, *S. algae*, *V. vulnificus*, and *Aeromonas spp* should all be included in the differential diagnosis. The possibility that the initial debridement was inadequate in our patient cannot be excluded in view of the fact that deterioration subsequently developed rapidly under prompt and aggressive surgery in combination with effective antibiotics.

Earlier studies have demonstrated that aminoglycosides, levofloxacin, third- and fourth-generation cephalosporins, piperacillin, and carbapenems are active *in vitro* against *S. putrefaciens*.[30,31] The antimicrobial susceptibilities of our clinical isolate were similar to those described previously.[25,31] Of note, imipenem had a higher MIC against the clinical *Shewanella* isolates than meropenem, as has been shown in other reports.[30,31] In terms of antimicrobial susceptibility, some *Shewanella* isolates are intrinsically resistant to imipenem,[31] while some that were originally susceptible to imipenem may develop resistance to this antibiotic after clinical exposure to it.[32] A chromosome-encoded carbapenem-hydrolyzing Amber class D β-lactamase harbored by the microbes has been reported to be responsible for the high MIC of imipenem against *S. algae* isolates.[31] Further study is warranted to clarify the role of empirical treatment with a carbapenem in soft tissue infections in patients with marine exposure.

Given the possible catastrophic consequences, education on the prevention of *Shewanella* soft tissue infections in at-risk people (e.g., the immunocompromised or elderly with a cutaneous ulcer) relating the need to avoid exposure to the marine environment or seawater may be of importance.

Conflict of interest: No conflict of interest to declare.

References

1. Forbes BA, Sahm DF, Weissfeld AS. *Alcaligenes*, *Bordetella* (nonpertussis), *Comamonas*, and similar organisms. *Bailey and Scott's diagnostic microbiology*. Eleventh ed. St. Louis, USA: Mosby, Inc.; 2002. p. 411–22.
2. Holt HM, Gahrn-Hansen B, Bruun B. *Shewanella algae* and *Shewanella putrefaciens*: clinical and microbiological characteristics. *Clin Microbiol Infect* 2005;**11**:347–52.
3. Khashe S, Janda JM. Biochemical and pathogenic properties of *Shewanella alga* and *Shewanella putrefaciens*. *J Clin Microbiol* 1998;**36**:783–7.
4. Simidu U, Kita TK, Yasumoto T, Yotsu M. Taxonomy of four marine bacterial strains that produce tetrodotoxin. *Int J Syst Bacteriol* 1990;**40**:331–6.
5. Nozue H, Hayashi T, Hashimoto Y, Ezaki T, Hamasaki K, Ohwada K, et al. Isolation and characterization of *Shewanella alga* from human clinical specimens and emendation of the description of *S. alga* Simidu et al., 1990, 335. *Int J Syst Bacteriol* 1992;**42**:628–34.
6. Trüper HG, De Clair L. Taxonomic note: necessary correction of specific epithets formed as substantives (nouns) 'in apposition'. *Int J Syst Bacteriol* 1997;**47**:908–9.
7. Weisburg WG, Barns SM, Pelletier DA, Lane DJ. 16S ribosomal DNA amplification for phylogenetic study. *J Bacteriol* 1991;**173**:697–703.
8. Lane DJ, Pace B, Olsen GJ, Stahl DA, Sogin ML, Pace NR. Rapid determination of 16S ribosomal RNA sequences for phylogenetic analyses. *Proc Natl Acad Sci USA* 1985;**82**:6955–9.
9. Debois J, Degreef H, Vandepitte J, Spaepen J. *Pseudomonas putrefaciens* as a cause of infection in humans. *J Clin Pathol* 1975;**28**:993–6.
10. Degreef H, Debois J, Vandepitte J. *Pseudomonas putrefaciens* as a cause of infection of venous ulcers. *Dermatologica* 1975;**151**:296–301.
11. Vandepitte J, Debois J. *Pseudomonas putrefaciens* as a cause of bacteremia in humans. *J Clin Microbiol* 1978;**7**:70–2.
12. Appelbaum PC, Bowen AJ. Opportunistic infection of chronic skin ulcers with *Pseudomonas putrefaciens*. *Br J Dermatol* 1978;**98**:229–31.
13. Schmidt U, Kapila R, Kaminski Z, Louria D. *Pseudomonas putrefaciens* as a cause of septicemia in humans. *J Clin Microbiol* 1979;**10**:385–7.
14. Eschete ML, Williams F, West BC. *Pseudomonas putrefaciens* and group A β-hemolytic streptococcus septicemia. *Arch Intern Med* 1980;**140**:1533–4.
15. Kim JH, Cooper RA, Welty-Wolf KE, Harrell LJ, Zwadyk P, Klotman ME. *Pseudomonas putrefaciens* bacteremia. *Rev Infect Dis* 1989;**11**:97–104.
16. Heller HM, Tortora G, Burger H. *Pseudomonas putrefaciens* bacteremia associated with shellfish contact. *Am J Med* 1990;**88**:85–6.
17. Chen SCA, Lawrence RH, Packham DR, Sorrel TC. Cellulitis due to *Pseudomonas putrefaciens*: possible production of exotoxins. *Rev Infect Dis* 1991;**13**:642–3.

18. Brink AJ, van Straten A, van Rensburg AJ. *Shewanella (Pseudomonas) putrefaciens* bacteremia. *Clin Infect Dis* 1995;**20**: 1327—32.
19. Domínguez H, Vogel BF, Gram L, Hoffmann S, Schaebel S. *Shewanella alga* bacteremia in two patients with lower leg ulcers. *Clin Infect Dis* 1996;**22**:1036—9.
20. Chen YS, Liu YC, Yen MY, Wang JH, Wang JH, Wann SR, et al. Skin and soft-tissue manifestations of *Shewanella putrefaciens* infection. *Clin Infect Dis* 1997;**25**:225—9.
21. Yohe S, Fishbain JT, Andrews M. *Shewanella putrefaciens* abscess of the lower extremity. *J Clin Microbiol* 1997;**35**:3363.
22. Papanaoum K, Marshmann G, Gordon LA, Lumb R, Gordon DL. Concurrent infection due to *Shewanella putrefaciens* and *Mycobacterium marinum* acquired at the beach. *Australas J Dermatol* 1998;**39**:92—5.
23. Leong J, Mirkazemi M, Kimble F. *Shewanella putrefaciens* hand infection. *Aust N Z J Surg* 2000;**20**:816—7.
24. Krsnik I, Arribalzaga K, Romanyk J. *Shewanella alga* bacteremia and associated cellulitis in a patient with multiple myeloma. *Haematologia* 2002;**32**:79—80.
25. Pagani L, Lang A, Vedovelli C, Moling O, Rimenti G, Pristerà R, et al. Soft tissue infection and bacteremia caused by *Shewanella putrefaciens*. *J Clin Microbiol* 2003;**41**:2240—1.
26. Bulut C, Ertem GT, Gökcek C, Tulek N, Bayar MA, Karakoc E. A rare cause of wound infection: *Shewanella putrefaciens*. *Scand J Infect Dis* 2004;**36**:692—4.
27. Tsai TH, You HY. Necrotizing fasciitis caused by *Shewanella putrefaciens* in a uremic patient. *J Microbiol Immunol Infect* 2006;**39**:516—8.
28. Liu JW, Lee IK, Tang HJ, Ko WC, Lee HC, Liu YC, et al. Prognostic factors and antibiotics in *Vibrio vulnificus* septicemia. *Arch Intern Med* 2006;**166**:2117—23.
29. Ko WC, Lee HC, Chuang YC, Liu CC, Wu JJ. Clinical features and therapeutic implications of 104 episodes of monomicrobial *Aeromonas* bacteraemia. *J Infect* 2000;**40**:267—73.
30. Iwata M, Tateda K, Matsumoto T, Furuya N, Mizuiri S, Yamaguchi K. Primary *Shewanella alga* septicemia in a patient on hemodialysis. *J Clin Microbiol* 1999;**37**:2104—5.
31. Héritier C, Poirel L, Nordmann P. Genetic and biochemical characterization of a chromosome-encoded carbapenem-hydrolyzing Ambler class D β-lactamase from *Shewanella algae*. *Antimicrob Agents Chemother* 2004;**48**:1670—5.
32. Kim DM, Kang CI, Lee CS, Kim HB, Kim EC, Kim NJ, et al. Treatment failure due to emergence of resistance to carbapenem during therapy for *Shewanella algae* bacteremia. *J Clin Microbiol* 2006;**44**:1172—4.