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Case report

Shewanella putrefaciens: A cause of bacteremia not to neglect

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ABSTRACT

Shewanella putrefaciens is a Gram-negative bacillus and marine pathogen that rarely causes disease in humans. We report the first Moroccan case of multidrug-resistant *Shewanella putrefaciens* bacteremia and describe the bacteriological, clinical, and antibiogram characteristics of this isolate, which was repeatedly isolated from the blood of a 66-year-old hypertensive man who underwent femoral coronary angiography after a myocardial infarction.

Introduction

Shewanella are Gram-negative, motile, non-fermentative bacilli possessing an oxidase and characterized by the presence of a thiosulfate reductase [1]. Among the many species of the genus Shewanella, only two species, *Shewanella putrefaciens* and *Shewanella algae*, are opportunistic pathogens, causing localized skin and soft tissue infections, more rarely generalized infections with bacteremia [1]. We report the first Moroccan case of multidrug-resistant *Shewanella putrefaciens* bacteremia and describe the bacteriological, clinical, and antibiogram characteristics of this isolate, which was repeatedly isolated from the blood of a 66-year-old hypertensive man who underwent femoral coronary angiography after a myocardial infarction.

Case report

This is a 66 year old hypertensive patient with a personal history of benign prostate hypertrophy under treatment and chronic smoking as well as a family history of coronary disease. The patient presented one day before his admission at 2 am a retrosternal, constrictive, thoracic pain, at rest, prolonged, without irradiation. Moreover, the patient reported a stage II dyspnea of the New York Heart Association (NYHA) classification. The infectious anamnesis showed a productive cough for 10 days with mictional pains.

Clinical examination on admission showed a conscious, apyretic patient. Cardiovascular examination revealed a hemodynamically stable patient with a heart rate of 81bpm, blood pressure of 151/90 mmHg, chest of normal morphology, peak shock in place, heart sounds well perceived with regular rhythm, no signs of right heart failure, no pericardial friction and peripheral pulses were present and symmetrical without murmurs on the path of the large accessible vascular axes.

The pleuropulmonary examination showed a respiratory rate of 20 cpm, O_2 saturation at 100%. The rest of the examination was unremarkable.

The electrocardiogram showed an inferobasal q-wave with a 1 mm ST-segment shift in the septal area.

The biological workup on admission is illustrated in Table 1.

The patient underwent coronary angiography via the femoral route. After coronary angiography, the patient became hemodynamically unstable with abdominal pain and right hypochondrial tenderness associated with a fever of 39 °C. Abdominal CT and angioscan of the lower limbs revealed the presence of a right retroperitoneal hematoma. The patient was transfused with three bags of packed red blood cells. Blood workup showed CRP at 205 mg/l, procalcitonin at 21 ng/mL, hyperleukocytosis at 19,000/mm^3 and hemoglobin at 9.6 g/dl. Three sets of blood cultures (aerobic and anaerobic vials) were sent to the bacteriology laboratory. After incubation in the automatic incubator BACTEC 9240 (Becton Dickinson France), the 06 bottles were positive after 48 h of incubation. Direct examination after Gram staining showed the presence of Gram-

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Table 1
Initial biological test on admission.

Biological workup	Results	Normal values
Troponin	1878 ng/mL	< 0.014 ng/mL
Blood cells	12,100 /mm^3	4–10/mm^3
Hemoglobin	15.3 g/dL	13–17 g/dL
Platelet count	290,000 /mm^3	150,000–450,000/mm^3
CRP	2.7 mg/L	< 5 mg/L
Aspartate aminotransferase	25 UI/L	5–34 UI/L
Alanine aminotransferase	15 UI/L	0–55 UI/L
Urea	0.35 g/L	0.15–0.55 g/L
Creatinine	8 mg/L	5.7–12.5 mg/L
TSH	2.1 µUI/mL	0.35–4.94 µUI/mL
FT3	1.9 pg/mL	1.71–3.71 pg /mL
FT4	1.1 ng/dL	0.7–1.48 ng/dL
Total cholesterol	2.5 g/L	1.50–2.20 g/L
HDL-cholesterol	0.35 g/L	0.40–0.60 g/L
LDL-cholesterol	1.8 g/L	0.8–1.6 g/L
Triglycerides	3.5 g/L	0.3–1.5 g/L

Table 2
Bacteriological and biochemical characteristics of *Shewanella putrefaciens* strain isolated from our patient.

Bacteriological and biochemical characteristics	Results
Gram staining	Gram-negative bacilli
Oxidase test	+
colonies	pigmented
Hemolysis on blood agar	–
Growth at or on:	
- 4 °C	+
- Environmental temperature	+
- 42 °C	–
- Salmonella-Shigella agar	–
Acid production from:	
- Maltose	+
- Glucose	+
- Saccharose	+
- Arabinose	+

negative Bacilli. The aerobic positive vials were plated on blood agar and cooked blood agar and incubated at 37 °C for 24 h. Anaerobic positive plates were plated on blood agar, blood agar + nalidixic acid-Nystatin-colistin and sheadler agar and incubated at 37 °C for 24 h in anaerobic conditions. All subcultures showed a monomorphic bacterial growth with pigmented, non-mucoid, non-hemolytic colonies on blood agar after 48 h of incubation, oxidase positive. An API 20NE® gallery (Bio- Mérieux, Marcy l'étoile France) allowed to identify 100% of the *Shewanella putrefaciens* group with an excellent identification (code 3051354). The API 20NE gallery, cannot distinguish between *Shewanella alga and Shewanella putrefaciens* [3]. Therefore, additional biochemical and bacteriological tests were performed to correctly identify the organism. Identification of the species as *S. putrefaciens* in this case was based on the criteria of Nozue et al. [2], and the results are presented in Table 2.

Antibiotic susceptibility testing was performed using the microdilution method using GNX2F*sensititre plates (Thermo Scientific™, France) from an 18–24 h culture. Interpretation of results was performed according to CASFM/EUCAST 2021 recommendations.

The sensitivity study showed a multi-resistant bacterium and it is sensitive only to amikacin, colistin, polymixin B, doxycycline and tigecycline (Table 3).

The patient was placed on probabilistic treatment with ceftriaxone and ciprofloxacin by the intravenous line for 3 days without any clinico-biological improvement. This treatment was corrected after the MIC results were available and the patient was then placed on tigecyline and amikacin by the intravenous line.The evolution after 10 days of treatment was favorable both clinically and biologically.

Table 3
Antibiotic susceptibility study of *Shewanella putrefaciens* strain.

Antibiotics	*Shewanella putrefaciens*	
	MIC (µg/mL)	Clinical categorization
Amikacine	< 4	sensitive
Aztreonam	> 16	resistant
Cefepim	> 16	resistant
Cefotaxim	> 32	resistant
Ceftazidim	> 16	resistant
Ciprofloxacin	> 2	resistant
colistin	< 0.25	sensitive
doripenem	> 2	resistant
Doxycyclin	< 2	sensitive
Ertapenem	> 4	resistant
gentamicin	> 8	resistant
Imipenem	> 8	resistant
Levofloxacin	2	sensitive
Meropenem	> 8	resistant
Minocyclin	> 16	resistant
Piperacillin/tazobactam 4	16/4	resistant
Polymixin B	< 0.25	sensitive
Ticarcillin/clavulanicacid 2	64/2	resistant
Tigecycline	1	sensitive
Tobramycin	> 8	resistant
Trimethoprim/sulfamethoxazole	> 4/76	resistant

Discussion

Shewanella spp have been associated with several types of infections such as biliary tract infection, empyema, skin and soft tissue infections such as fulminant periorbital cellulitis, dacrycystitis, perianal abscess, finger abscess, traumatic injury or burns of the lower limbs, bacteremia and rheumatic heart disease. It has also been reported in premature babies with pneumonia [3]. Most of these patients had predisposing factors such as malignancy, hepatobiliary disease, neutropenia or prematurity.

The first description of the species was provided in 1931 by Derby and Hammer [4] Initially, the *Shewanella alga* was misidentified as *Shewanella putrefaciens* by most researchers; it was not until 1980, when Gillardy [5] recognized three biovars and CDC recognized two biotypes based on carbohydrate oxidation and growth on SS agar and nutrient agar containing a high concentration of salt (6.5%). Prior to the identification of Shewanella, most human infections caused by *Shewanella spp* were assumed to be caused by *Shewanella putrefaciens*, which was first reported in clinical isolates by King et al. [6]. In 1990, Simidu et al. [6], proposed the name *Shewanella alga* for a tetrodotoxin-producing isolate recovered from red algae.

Later, several other phenotypic and genotypic characteristics were described to differentiate the two biotypes. Recent results of 16 S rRNA gene sequence analyses of genera in this group have led to a proposal for a new family called Shewanellaceae, containing about 30 *Shewanella spp* most of which are psychrophilic and thus of little interest to clinical microbiologists [5]. The only *Shewanella spp* found in clinical specimens are *Shewanella putrefaciens* and *Shewanella algae.*

The most frequently described clinical syndrome in the literature is skin and soft tissue infection, associated with skin breaches such as ulcers or following trauma [6–14]. Bacteremia is often present, but the course is usually benign. In about 40 published reports, 40% of the cases involved pure cultures of Shewanella. This is in accordance with our case in which *Shewanella putrefaciens* was repeatedly isolated in pure culture. Two cases of *Shewanella alga* bacteremia, one with myonecrosis, involving patients with chronic ulcers have been

reported in Denmark [12]. Primary bacteremia, associated with severe hepatobiliary disease and malignancy with an often fulminant course, has also been described [6,10,15]. A distinction between these two syndromes is not always possible, as cases involving both cellulitis and underlying debilitating disease have been described [16].

Another clinical syndrome, so far described only in South Africa, is pediatric bacteremia in underweight babies [6], with 19 cases occurring in two hospitals between 1990 and 1993 [16]. Of 16 neonates, all had respiratory distress at birth and six subsequently died [16]. In 12 cases, the organism was isolated shortly after birth, indicating the possibility of intrapartum infection [16].

In this case, we report the first case in Morocco of *Shewanella putrefaciens* bacteremia secondary to coronary angiography, which was complicated by a retroperitoneal hematoma and setic shock, in a hypertensive patient admitted for myocardial infarction in our institution, with a good evolution under medical treatment. Our patient was not exposed to seawater and therefore the most likely entry point remains related to the catheter used for coronary angiography. In the literature, *Shewanella spp* has been associated with medical devices in rare cases and can lead to healthcare-associated infections and epidemics [17].

Shewanella algae and *Shewanella putrefaciens* are generally susceptible to aminoglycosides, carbapenems, erythromycin, and quinolones, but resistant to penicillin [10,15,18–21]. Susceptibility to ampicillin and cephalosporins is variable, with isolates being more susceptible to third- and fourth-generation cephalosporins than to first- and second-generation cephalosporins [15,18,20,21]. All isolates of *Shewanella algae* were resistant to colistin and polymixin B [16]. Polymyxin susceptibility can be used to differentiate between the two species [16]. In our case, we report a multidrug resistant *Shewanella putrefaciens* strain contrary to what has been reported in the literature. Our isolate was sensitive to amikacin, colistin, polymixin B and tigecycline, which renders our report the first case in which we have isolated a multidrug resistant *Shewanella putrefaciens* species. The emergence of multidrug resistant strains will complicate the therapeutic management.

Conclusion

Through this case, we highlight the emergence of multi-resistant strains of *Shewanella putrefaciens* in our institution, which will improve the management of our patients. Epidemiological surveillance is necessary to limit the spread of this germ.

CRediT authorship contribution statement

All persons who meet authorship criteria are listed as authors, and all authors certify that they have participated sufficiently in the work to take public responsibility for the content, including participation in the concept, design, analysis, writing, or revision of the manuscript. Furthermore, each author certifies that this material or similar material has not been and will not be submitted to or published in any other publication before its appearance in the ID Cases journal.

Competing interests

The authors declare no competing interest.

Author contributions

BE have been involved in drafting in the manuscript, MA ha revising the manuscript and ELM have given final approval of the version to be published.

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