Case Report

First case report of dermohypodermitis caused by *Shewanella algae* in Tunisia in a sickle-cell patient and literature review.

Premier cas rapporté de dermohypodermite à *Shewanella algae* en Tunisie chez un patient drépanocytaire et revue de la littérature.

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Abstract

Introduction : *Shewanella algae* (*S. algae*) is an opportunistic bacterium, widespread in the marine environment, that can cause soft tissue infections often secondary to trauma.

Objectives : We report the first case of *S. algae* dermohypodermitis in a diabetic with sickle cell disease.

Case report : A 51-year-old man with homozygous sickle cell disease and type 2 diabetes, who occasionally worked at the fish market, was admitted to La Rabta University Hospital for dermohypodermitis of the leg. He received amoxicillin and clavulanic acid based antibiotic therapy combined with debridement of tissues of doubtful vitality. Intraoperative specimens were cultured on agar plates: nutritive agar, blood agar (horse 5%), cooked blood agar supplemented with Polyvitex® (bioMérieux®, France) and Drigalski agar and in heart-brain broth. An anaerobic culture was simultaneously performed on blood agar. Identification was performed by VITEK-2 (bioMérieux®, France) and showed *Klebsiella pneumoniae* and a gram-negative, salmon-brown mucoïd bacillus on blood agar and cooked blood agar, identified as *S. algae*. Antibiotics testing was realized according to CA-SFM/EUCAST (2020) recommendations with sensitivity to third generation cephalosporins, piperacillin/tazobactam and aminoglycosides. The patient improved after adaptation of antibiotic therapy.

Conclusion : This case underlines the importance of considering *Shewanella spp*. as a cause of soft tissue infections acquired in open water.

Keywords : Dermohypodermatitis, *Shewanella algae*, sickle-cell disease, diabetes

Résumé

Introduction : *Shewanella algae (S. algae)* est une bactérie opportuniste, répandue en milieu marin, pouvant être à l'origine d'infections des tissus-mous souvent secondaires à un traumatisme.

Objectif : Nous rapportons le premier cas de dermohypodermite à *S. algae* chez un diabétique drépanocytaire.

Etude de cas : Un homme de 51 ans, drépanocytaire homozygote et diabétique type 2, travaillant occasionnellement au marché aux poissons, a été admis au CHU La Rabta pour une dermohypodermite de la jambe non améliorée par une antibiothérapie antérieure. Il y a reçu une antibiothérapie à base d'amoxicilline/acide clavulanique associée à un débridement des tissus de vitalité douteuse.

Les échantillons per-opératoires ont été cultivés sur géloses : gélose nutritive, gélose au sang de cheval à 5%), gélose au sang cuit additionnée de Polyvitex® (BioMérieux®, France) et gélose Drigalski et dans du bouillon cœur-cervelle. Une culture en milieu anaérobie a été faite simultanément sur gélose au sang. L'identification a été réalisée par l'automate VITEK-2 (bioMérieux®, France) et a mis en évidence *Klebsiella pneumoniae* et un bacille Gram négatif, oxydase et catalase positives, d'aspect mucoïde brun-saumon sur gélose au sang et sur gélose au sang cuit, et lactose négatif sur Drigalski identifié en tant que *S. algae.* L'antibiogramme a été interprété selon les recommandations CA-SFM/EUCAST (2020) et la souche a montré une sensibilité aux céphalosporines de troisième génération, pipéracilline/tazobactam et aminoglycosides. Le patient s'est amélioré après adaptation de l'antibiothérapie.

Conclusion : Ce cas souligne l'importance de considérer *Shewanella spp.* comme cause d'infections des tissus mous contractées en eau libre.

Mots-clés : dermohypodermite, *Shewanella algae,* drépanocytos*e,* diabète.

INTRODUCTION

Dermohypodermatitis is a bacterial derma and hypoderma infection leading to necrosis considered as a medical and surgical emergency.

It is frequently polymicrobial (1) and occasionally involves uncommon microorganisms such as *Shewanella algae* (*S. algae*) which is a gram-negative, non-fermentative, oxidase positive, mobile marine bacterium that produces hydrogen sulfide gas (2).

S. algae is a rare cause of infection in humans (3) and is reported in warm climates (4). The major pathway of infection in humans is through the skin *via* direct contact with marine water or by ingestion of raw seafood (5).

The most common clinical syndromes reported from *S. algae* infection included soft tissue infections, cellulitis, osteomyelitis, bacteraemia and acute exacerbations of chronic otitis in predisposed individuals (6– 8).

We report a rare case of dermohypodermitis caused by *S. algae* in a homozygous sickle cell patient in Tunisia.

A 51-year-old man, with diabetes type 2 and homozygous sickle cell disease as medical history, was referred to La Rabta University Hospital of Tunis over 2 months of swelling, erythema and left leg pain.

At the admission examination, he had no fever, his blood pressure was 140/90 mm Hg and pulse was 100 bpm. The clinical exam revealed no abnormalities except a 4 cm ulceration on the lower third of anterior shin splint and swelling of all the leg.

The patient did not have a permanent job and occasionally worked in a fish market.

The blood samples showed hemoglobin 9,8 g/dL, platelet count 1.63 $\times 10^5/mm^3$, total WBC count 13400/mm^3 with 73.8% polymorphonuclear leukocytes (PMN), urea 1.9 mmol/L, creatinine 51.9 µmol/l, conjugated bilirubin 15 µmol/L, unconjugated bilirubin 13 µmol/L, aspartate aminotransferase and alanine aminotransferase were 21 and 20 UI/L.

Parenteral amoxicillin and clavulanic acid (3 g/day) was administered empirically after blood cultures and an urgent surgery was performed. Surgical procedure included fasciotomy and extensive debridement of the affected leg's soft tissue and wide excision (Figure 1).

Debridement was performed until a viable bleeding from the tissue was observed.

Underlying muscles were found to be pale but with retained vitality and no evidence of infection. The remaining leg was swollen, infiltrated and painful on palpation. The knee and ankle had normal range of motion.

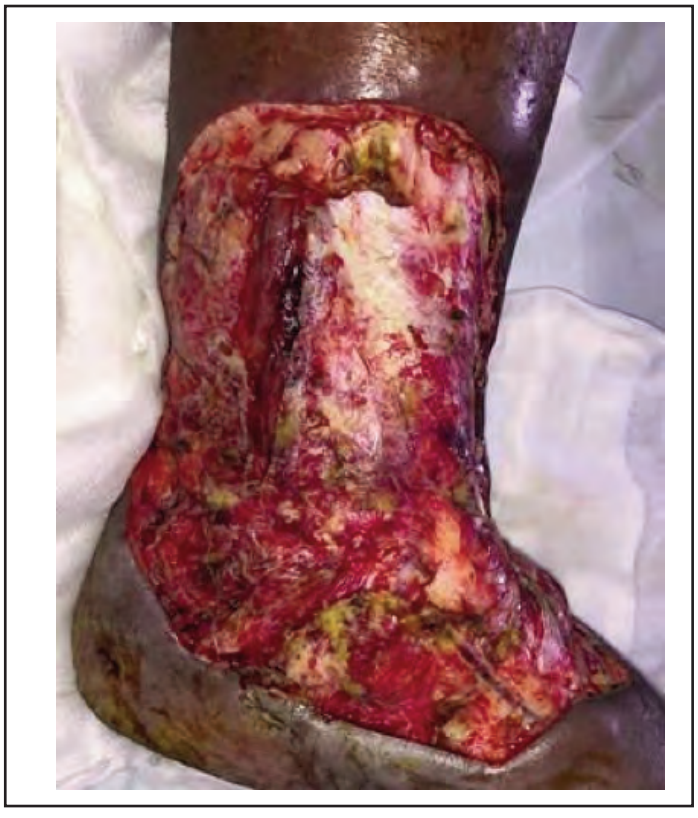

Figure 1: Ankle aspect after wide excision

Soft-tissue samples were collected per-operatively and sent to the Microbiology laboratory. Bacteriological samples were inoculated in 5% horse blood agar, ordinary agar, chocolate agar with Polyvitex (bioMérieux, France), Drigalski agar, and heart-brain broth and was simultaneously processed for anaerobic culture in a 5% horse blood agar. After 24 hours, 2 types of colonies suggestive of Gram-negative bacilli were observed on all plates. The first type was identified by VITEK-2 as *Klebsiella pneumoniae* producing extended spectrum beta-lactamase and was susceptible to amoxicillin/acid clavulanic, piperacillin/tazobactam, carbapenem and resistant to fluoroquinolone. The second type of colonies had an unusual appearance: salmon-brown mucoid on non-chromogenic plates (Figure 2a and 2b). On Drigalski agar, they were non fermentative colonies (Figure 3). Oxidase and catalase tests were positive.
Confirmation by the VITEK-2 system (bioMérieux, France) gave an excellent identification of *S. algae*.
Susceptibility testing using diffusion method in Mueller-Hinton indicated that the *S. algae* was susceptible to piperacillin/tazobactam, ceftriaxone, ciprofloxacin, imipenem, meropenem, gentamicin, amikacin, trimethoprim–sulfamethoxazole and resistant to cephalothin and fosfomycin. In accordance with these new data, the antibiotic therapy was changed to piperacillin/tazobactam (4 g x3/day) and gentamicin (240 mg/day). The patient improved after adaptation of antibiotic therapy.

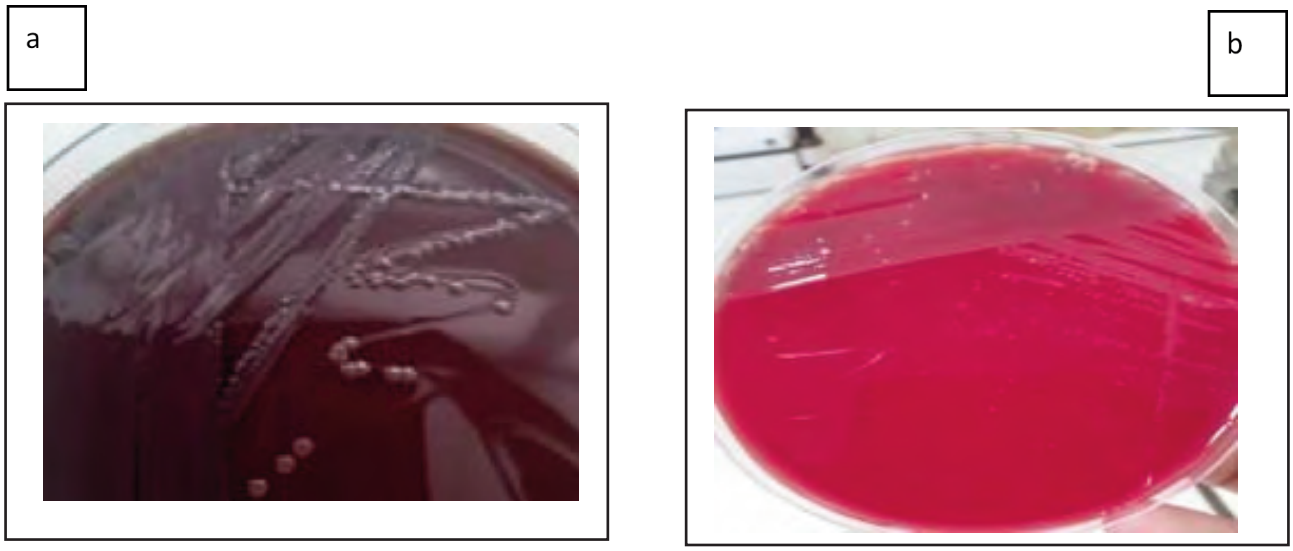

Figure 2: Salmon-brown mucoïd of *S. algae* on (a): chocolate agar; (b): 5% horse blood agar

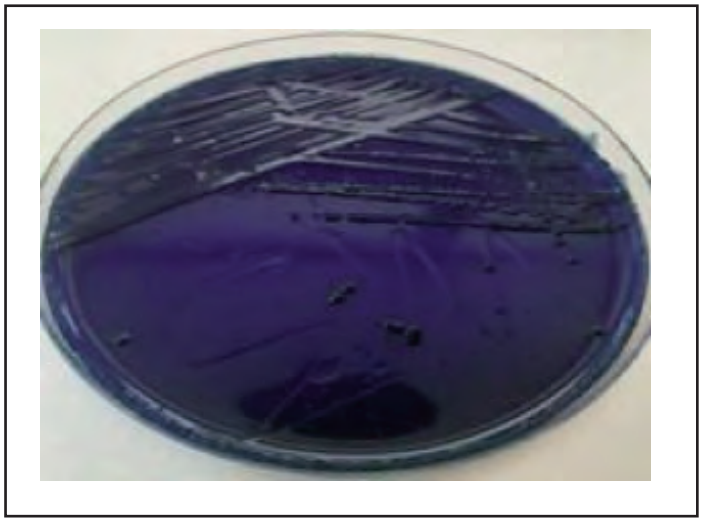

Figure 3: Non fermentative colonies of *S. algae* on Drigalski agar

DISCUSSION

As far as we know, this is the first case of necrotizing soft tissue infection caused by *S. algae* in a sickle cell patient reported in North Africa.

Shewanella spp. was first described in 1931 by Derby and Hammer from putrefied butter and water supplies of dairies (9). In 1941, Long and Hammer classified the bacterium as *Pseudomonas putrefaciens* based on morphology (10). It was reclassified in 1972 as *Alteromonas putrefaciens* on the basis of its GC content (11). In 1985, it was classified in a new genus *Shewanella* (12*)*. Recent results of *16S rRNA* gene sequence analyses led to a proposal for a new family called *Shewanellaceae*, containing about 30 *Shewanella spp* (13). The most frequent species of *Shewanella* described in humans are *S. putrefaciens* and *S. algae* and more than 80% of clinical isolates were *S. algae* (4). According to some studies, *S. algae* pathogenicity is largely related to its hemolysin production (14-16).

Shewanella is an opportunistic organism rarely involved in human infections mainly in immunocompromised individuals (17, 18). It has been associated with several kinds of infections like biliary tract infection, empyema, skin, and soft tissue infections such as fulminant periorbital-facial cellulitis, necrotizing fasciitis, spondylodiscitis, dacryocystitis, perianal abscess, finger abscess, traumatic lesions or burns of the lower limbs, bacteremia and rheumatic heart disease. It has also been reported in premature babies with pneumonia (3). Reported gateway of infection include leg ulcers, chronic skin breakdowns, superinfection of open fractures, and infection of blisters (19).

Shewanella spp is motile, facultative anaerobic gram-negative bacilli belonging to the marine environment whose geographical distribution is limited to areas with warm climates (5, 20). Infection usually occurs via contact with seawater or consumption of raw seafood (21).

Risk factors reported in *Shewanella* infections included renal failure, snake bite, seawater exposure, raw seafood ingestion, marine environment, prematurity, diabetes, peripheral vascular disease, chronic liver disease and use of steroids and immunodeficiency (22). Also, seawater exposure of a wound is a significant risk factor for *Shewanella* infection (4). Skin and soft tissue infections complicating marine lesions generally include erysipelas, impetigo, cellulitis, and necrotizing infections (23).

In our case, the patient was type 2 diabetes mellitus and homozygous sickle cell disease. Chronic diseases facilitate the occurrence of infection (24). The most important contributing factors to increase susceptibility of sickle cell patients to bacteria are: a state of functional asplenia, an opsonophagocytic defect due to an abnormality of the alternative complement pathway, and a deficiency of specific circulating antibodies. Devitalization of gut and bone due to repetitive vaso-occlusive crises, saturation of the macrophage system with red cell breakdown products of chronic haemolysis, and underlying splenic and hepatic dysfunction all predispose to infections. Also, local edema enhances rapid proliferation after bacterial colonization, leading to infection and subsequent tissue necrosis (25).

Marine necrotizing infections can be monomicrobial or polymicrobial and can progress rapidly to necrotizing fasciitis and myonecrosis, especially in patients with venous stasis ulcers and those who are immunocompromised (23). *Shewanella spp* was often isolated from cases of polymicrobial infection. Most of the strains co-isolated from such polymicrobial infections were *Enterobacteriaceae* (17, 26). It is the case for our study where we have isolated *S. algae* and *K. pneumoniae* in pus culture.

S. algae is a non-fermentative bacilli with a single polar flagellum. It grows well on conventional solid media, including chocolate agar, with 1–2-mm yellowish-brown colonies after incubation for 18–24 h. Characteristic traits include production of hydrogen sulfide, producing acid only from ribose, and sometimes from glucose and fructose. *S. algae* shows weak β-haemolysis on sheep blood agar after incubation for 48 h, as well as growth at 42° C and in NaCl 6% w⁄v. Holt *et al.,* also found that *S. algae* had a mucoïd colony consistency and an ability to reduce nitrite (8, 27).

The antibiotic sensitivity indicated that *S. algae* was susceptible to the association piperacillin-tazobactam, ceftriaxone, ciprofloxacin, imipenem, meropenem, gentamicin, amikacin trimethoprim–sulfamethoxazole and resistant to cephalothin and fosfomycin. According to the literature *S. algae* is characteristically susceptible to aminoglycosides, carbapenems, erythromycin and quinolones, but resistant to penicillin (4, 28). Most *Shewanella* infections are treated easily by a combination of surgical therapy, drainage and antibiotics. Poor outcome is sometimes associated with underlying disease (29). Treatment includes beta-lactams, aminoglycosides and quinolones.

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Conflicts of interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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