Infect Dis Trop Med 2022; 8: e796

Wound infection caused by *Photobacterium damselae* in a man in Sardinia (the first case in Italy): a case report and review of literature

G. Caddia[1], M.A. Casu[2], S. Dettori[2], R. Urru[3], B. Paglietti[3,4]

[1]Department of Human Pathology, Division and Residency Program in Plastic, Reconstructive and Aesthetic Surgery, University of Messina, Messina, Italy
[2]Division of Vascular Surgery, Azienda Ospedaliera Universitaria, Sassari, Italy
[3]SC Microbiologia e Virologia, Azienda Ospedaliera Universitaria, Sassari, Italy
[4]Department of Biomedical Sciences, University of Sassari, Sassari, Italy

ABSTRACT:

Photobacterium damselae subsp. *damselae* is commonly associated with infections in a variety of marine animals and rarely in humans. The authors report the first occurrence in Italy of an infection in a 44-year-old man caused by *Photobacterium damselae* on a pre-existing wound on the posterior face of the leg, acquired after diving in the coastal area of Platamona in Sardinia during the summer period. Besides the clinical case, we present the microbiological investigations and a systematic review of literature.

Keywords: *Wound infection, Human infection, Photobacterium damselae, Vibrio damselae, First report in Italy.*

INTRODUCTION

Photobacterium damselae (*P. damselae)* subsp. *damselae* is a gram-negative marine bacterium of the family of *Vibrionaceae*. Formerly known as *Vibrio damsela*[1] was introduced in bacterial taxonomy as *P. damselae* in 1991[2]. *P. damselae* has been detected in sea water and is a well-known fish pathogen, causing wound infections and hemorrhagic septicemia. The two hemolysins damselysin and phobalysin, encoded respectively by *dly* and *hlyA* genes, have been identified as the main virulence factors for fish[3]. Besides this, *P. damselae* can behave as an opportunistic pathogen and cause infections in humans, occasionally with fatal outcome due to rapidly progressing necrotizing fasciitis and sepsis[4], that frequently originate from minor injuries after contact with sea water or fish. On the other hand, cases of localized skin infections are described, mostly resulting in complete healing[5-19].

Most of the human cases occurred in coastal areas of the United States of America (USA), Australia, Japan and China. However, there are also reports[15,17,18] from other countries including South Korea, Bahamas, Jamaica, Greece, Spain and Portugal. To date, only two cases have been reported from the Mediterranean basin[15,17] and to our knowledge, this is the first human case described in Italy.

Here, we report on a wound infection in a 44-year-old man, which was caused by *P. damselae* after diving in the coastal area of Platamona in Sardinia, Italy, and we describe the methods of cultivation, identification, and antimicrobial susceptibilities.

CASE DESCRIPTION

In August 2020, a 44-year-old Caucasian male, smoker (20 cigarettes per day) and obese (BMI: 41,18 kg/m^2), affected by arterial hypertension with overload of the right ventricle, came to our attention for an infected wound on the posterior area of the left leg (calf).

He recalled the onset of little skin ulcers on the aforementioned body area in May 2019, without being able to trace the triggering factor and referred to a gradual enlargement of these lesions without macroscopic signs of infection, due to inferior limb edema starting

Corresponding Author: Giorgio Caddia, MD; e-mail: giorgio.cadd@gmail.com

Figure 1. Ulcer on the posterior face of the calf, first glance at the emergency room.

from January 2020. Underestimating these skin lesions and his general medical conditions, the patient frequently went to dive in the sea on coastal area of Platamona in Sardinia, Italy, until he assisted to the clinical worsening of one ulcer, characterized by volumetric increase, hyperemia, and pain in August 2020. At this stage he was sent to our attention by his family doctor.

Clinically, we observed a major ulcer covered by an eschar, with hyperemia, swelling and extreme pressure-pain, with a diameter of 4x3 cm on the posterior face of the calf (Figure 1), accompanied with two inconspicuous satellite ulcers. The patient did not present any systemic signs of infection. Then, we proceeded with wound cleaning and removal of the eschar, collection of microbiological samples and disinfection.

The patient received empirical antibiotic treatment with amoxicillin and clavulanic acid administered orally (1000 mg x 3/day for 14 days). Following microbiological results, the therapy was adjusted by the application of topical amikacin during our daily care. We assisted to complete healing of the ulcer without further complications in about 4 months.

Microbiological Methods and Results

The sample was collected from the wound with a Transport swab, cultured on Columbia agar with sheep blood (Thermo Scientific™, Germany), MacConkey, Mannitol, and Sabouraud agar (incubated in aerobic conditions), Schaedler agar plates (incubated in a jar in anaerobic conditions), and incubated for 24-48 hours at 37°C. Accurately identification at species level of *P. damselae* subsp. *damselae* from small haemolytic colonies grew on blood agar plates at 48 hrs was performed by Matrix Assisted Laser Desorption Ionization Time-of-Flight (MALDI-TOF MS), (VITEK® MS, Biomerieux). The antimicrobial susceptibility testing of *P. damselae* was performed on blood agar plates by Kirby-Bauer disk diffusion method using amoxicillin-clavulanate (20/10 µg), ceftazidime (30 µg), ertapenem (10 µg), meropenem (10 µg), amikacin (30 µg), vancomycin (30 µg), piperacillin-tazobactam (100/30 µg), ciprofloxacin (5 µg), cefepime (30 µg), gentamicin (10 µg) and erythromycin (15 µg), following the Clinical and Laboratory Standards Institute (CLSI) guidelines for *Vibrio* species. The isolate displayed susceptibility to almost all antimicrobials but showed resistance towards gentamicin and erythromycin.

DISCUSSION

To the best of our knowledge, a total of 34 confirmed case descriptions of *P. damselae* infections in humans (including the present report) are described to date in different countries, with the USA reporting the highest case rate (Table 1)[4-29]. An infection has always developed following contact with sea water (the natural reservoir of *P. damselae*) or marine wildlife[3]. As well, the majority of human infections caused by *P. damselae* started after bacterial entry into the host through cutaneous continuum solutions, where it can cause localized infections or make its way into deep tissues, resulting in necrotizing fasciitis and septic states (Table 1). The case presented here has in common the role of sea water in the transmission of *P. damselae*, since the patient showed a wound infection after diving in the sea. However, cases of generalized infections have also been reported after ingestion of raw fish[19,28]. Whether this type of infection pathway is determined by entry of *P. damselae* into the organism through lesions in the mucosa of the gastrointestinal tract or that it has other pathogenic capacities still remains unclear.

Notably, in depth analysis of the available literature highlighted that most of young patients fully recovered from the infection (*n*= 23; average age= 39.6 years) whilst the fatal cases tended to affect (but are not exclusive to) more old patients (*n*= 11; average age= 64 years) or patients with severe comorbidities (Table 1). In this case, the patient was 44 years old and the course of the disease was favourable, which is in accordance with previously reported observations (Table 1).

Although *P. damselae* strains from human infections have been reported to be sensitive to most antibiotics, in some cases exhibited resistance to aminoglycosides, beta-lactams and sulfamides[17,25]. In line with previous reports, our *P. damselae* isolate was susceptible to almost all the antibiotics ttested butshowed resistance to aminoglycosides (amikacin being an exception) and macrolides. The most plausible mechanism of resistance to aminoglycosides displayed by our isolate could be associated with enzymatic inactivation by AMEs (aminoglycosides modifying enzymes), which act on gentamicin but do not affect amikacin[30]. On the other hand, for macrolide resistance, three possible mechanisms could be taken into account: dimethylation of the 23S rRNA, decreased accumulation of the antibiotic (e.g., enhanced efflux) and enzymatic inactivation of the antibiotic (e.g., hydrolysis, phosphorylation)[31]. However, other molecular studies are required to elucidate the exact molecular mechanism for both antimicrobial resistances.

Table 1. Overview of human infections caused by *Photobacterium damselae.*

Year	Age	Sex	Country	Affected area	Underlying disease	Outcome	Additional information	Reference
1982	41	Male	N/A[‡]	Wound	n.p.i.r.[†]	Healed	*Peptostreptococcus* spp. additionally detected	5
1982	26	Male	N/A	Wound	n.p.i.r.	Healed	*S. aureus* additionally detected	5
1982	55	Male	N/A	Foot	n.p.i.r.	Healed	*Clostridial species* additionally detected	5
1982	32	Male	N/A	Leg	n.p.i.r.	Healed		5
1982	40	Female	Bahamas	Foot	n.p.i.r.	Healed		5
1982	47	Male	N/A	Wound	n.p.i.r.	Healed	*Enterococcus* spp., *Acinetobacter* spp., *P. putrefaciens* additionally reported	5
1985	61	Male	USA (Texas)	Hand (up to shoulder)	Alcoholism, chronic pancreatitis, diabetes mellitus	Deceased	Rapid disease progression, DIC[§], AKI[¶], death in cardiac arrest, contact with fish, two variants of P. damselae	4
1986	38	Male	USA (Texas)	Middle finger (up to axilla)	Diabetes mellitus	Healed		6
1989	20	Male	Australia (Sidney)	Leg	n.p.i.r.	Healed	Vibrio alginolyticus additionally detected	7
1989	35	Male	Australia (near Sidney)	Ankle	n.p.i.r.	Healed	Vibrio parahaemolyticus additionally detected	7
1989	11	Male	Australia (near Sidney)	Thigh	n.p.i.r.	Healed		7
1993	62	Male	China (Hong Kong)	Hand (up to shoulder including M. pectoralis major and M. latissimus dorsi)	n.p.i.r.	Deceased	rapid disease progression, septic shock, DIC[§], AKI[¶], necrotizing fasciitis	20
1993	70	Male	USA (New Jersey)	Middle finger (up to entire arm and left chest wall)	Mitral valve replacement, coronary artery bypass	Deceased	Rapid disease progression, phlegmon, septicemia, contact with fish	21
1996	63	Male	Korea	Arm and hand	Alcoholic liver disease, diabetes mellitus	Deceased	Rapid disease progression, septicemia	22
1997	64	Male	USA (Texas)	Hand (up to elbow)	Atherosclerotic heart disease, ventricular arrhythmias	Deceased	death probably caused by bacterial toxins	23
1999	62	Male	China (Hong Kong)	hand and forearm (up to entire arm and chest wall)	n.p.i.r.	Deceased	Necrotizing fasciitis	24
2000	43	Male	USA (Florida/Tampa Bay)	Lower leg	n.p.i.r.	Healed		8
2004	58	Male	Japan (Okinawa)	Hand and arm	Diabetes mellitus	Deceased	Rapid disease progression, AKI[¶], death	25,26

Table 1 ***Continued.*** Overview of human infections caused by *Photobacterium damselae.*

Year	Age	Sex	Country	Affected area	Underlying disease	Outcome	Additional information	Reference
2004	76	Male	Japan (Okayama)	Thumb, hand (up to shoulder)	n.p.i.r.	Deceased	Rapid disease progression and death due to multi-organ failure	25
2004	69	Male	USA (Boston, Massachusetts)	Fifth finger (up to shoulder, neck, back, chest, flank)	n.p.i.r.	Deceased	rapid illness progression based on a soft tissue infection	27
2005	2	Male	Jamaica (Kingston)	Buttock	Sickle-cell disease	Healed	E. coli in urine specimen, contact with fish	9
2006	22	Female	USA (Puerto Rico)	Urinary tract	n.p.i.r.	Healed	Pregnancy (23rd week of gestation), contact with sea water	10
2008	68	Male	Japan (Yamaguchi)	Lower leg	Diabetes mellitus	Healed		11
2009	14	Male	USA (Florida, Jacksonville)	Ankle	n.p.i.r.	Healed		12
2009	46	Male	South Korea (Seoul)	Blood	Liver cirrhosis (Child-Pugh Class B)	Deceased	Food (raw fish meal) associated	28
2013	64	Male	Australia (estuary of the Murchinson River)	Lower leg	n.p.i.r.	Healed	Vibrio harveyi additionally detected (not reliably identified, could also be Vibrio rotiferanus or Vibrio communis)	13
2015	75	Male	Australia (Sidney)	Hand and forearm	Hypertension, hyper-cholesterolaemia, penicillin allergy	Healed	Vibrio harveyi additionally detected	14
2019	44	Male	Greece	Knee (Gustilo IIIB fracture)	n.p.i.r.	Healed	Vibrio harveyi additionally detected	15
2020	74	Female	USA (Worchester, Massachusetts)	Foot	(Controlled) hypertension	Healed		16
2020	32	Female	Spain	Lower leg	Alcoholism	Probably-healed		17
2021	65	Male	Portugal	Hand and forearm	Chronic kidney disease in haemodialysis	Healed	Necrotizing fasciitis, septic shock	18
2021	74	Male	USA (Texas)	Second finger to forearm	Non-insulin-dependent diabetes, hypertension, prior pacemaker placement for brady-arrhythmia	Deceased	Necrotizing fasciitis, rapidly progressing multi-organ failure	29
2021	63	Male	Japan (Kunamoto)	Leg, blood	Liver cirrhosis (Child-Pugh class B)	Healed	Cellulitis and bacteraemia after contact with brackish water and raw fish meal	19
2021	44	Male	Italy (Sardinia)	lower leg	Nicotine abuse, hypertension with right ventricle pump failure	Healed		Current report

† n.p.i.r.= no previous illnesses reported;
‡ N/A= not available
§ DIC= disseminated intravascular coagulation
¶ AKI= acute kidney injury

CONCLUSIONS

We report the first case in Italy of human infection caused by *P. damselae*, which represents one of the three cases reported in the Mediterranean basin and the 34th of the global cases. *P. damselae* is recognized as an opportunistic pathogen for humans. Even causing localized infections in most cases, it can also cause severe infections. Thus, early identification and proper therapy are mandatory in reducing the risk of fatal outcome. *P. damselae* infections affecting younger patients (this case included) once again seem to have a better outcome than those affecting over-60-year-old patients. This study aims to be an inspiration for other researchers to engage in further studies and update the cases already reported.

Informed Consent:
Obtained

Funding:
This research was funded by the University of Sassari, grant FAR 2020 (Fondo di Ateneo per la ricerca 2020) given to BP.

Acknowledgements:
BP is supported by Sardinian Region [POR-FSE 2014-2020-Asse Prioritario 3 "Istruzione e Formazione"-Obiettivo Tematico: 10, Priorità d'investimento: 10ii, Obiettivo Specifico: 10.5, Azione dell'Accordo di Partenariato 10.5.12-C.U.P. J86C18000270002].

Conflict of Interest:
The authors declare that they have no conflict of interests.

REFERENCES

1. Love M, Teebken-Fisher D, Hose JE, Farmer JJ 3rd, Hickman FW, Fanning GR. Vibrio damsela, a Marine Bacterium, Causes Skin Ulcers on the Damselfish Chromis punctipinnis. Science 1981; 214: 1139-1140.
2. Smith SK, Sutton DC, Fuerst JA, Reichelt JL. Evaluation of the genus Listonella and reassignment of Listonella damsela (Love et al.) MacDonell and Colwell to the genus Photobacterium as Photobacterium damsela comb. nov. with an emended description. Int J Syst Bacteriol 1991; 41: 529-534.
3. Rivas AJ, Lemos ML, Osorio CR. Photobacterium damselae subsp. damselae, a bacterium pathogenic for marine animals and humans. Front Microbiol 2013; 4: 283.
4. Clarridge JE, Zighelboim-Daum S. Isolation and characterization of two hemolytic phenotypes of Vibrio damsela associated with a fatal wound infection. J Clin Microbiol 1985; 21: 302-306.
5. Morris JG Jr, Miller HG, Wilson R, Tacket CO, Hollis DG, Hickman FW, Weaver RE, Blake PA. Illness caused by Vibrio damsela and Vibrio hollisae. Lancet 1982; 1: 1294-1297.
6. Coffey JA Jr, Harris RL, Rutledge ML, Bradshaw MW, Williams TW Jr. Vibrio damsela: another potentially virulent marine vibrio. Infect Dis 1986; 153: 800-802.
7. Dryden M, Legarde M, Gottlieb T, Brady L, Ghosh HK. Vibrio damsela wound infections in Australia. Med J Aust 1989; 151: 540-541.
8. Barber GR, Swygert JS. Necrotizing fasciitis due to Photobacterium damsela in a man lashed by a stingray. N Engl J Med 2000; 342: 824.
9. Knight-Madden JM, Barton M, Gandretti N, Nicholson AM. Photobacterium damsela bacteremia in a child with sickle-cell disease. Pediatr Infect Dis J 2005; 24: 654-655.
10. Alvarez JR, Lamba S, Dyer KY, Apuzzio JJ. An unusual case of urinary tract infection in a pregnant woman with Photobacterium damsela. Infect Dis Obstet Gynecol 2006; 2006: 80682.
11. Nakamura Y, Uchihira M, Ichimiya M, Morita K, Muto M. Necrotizing fasciitis of the leg due to Photobacterium damsela. J Dermatol 2008; 35: 44-45.
12. Aigbivbalu L, Maraqa N. Photobacterium damsela wound infection in a 14-year-old surfer. South Med J 2009; 102: 425-426.
13. Hundenborn J, Thurig S, Kommerell M, Haag H, Nolte O. Severe Wound Infection with Photobacterium damselae ssp. damselae and Vibrio harveyi, following a Laceration Injury in Marine Environment: A Case Report and Review of the Literature. Case Rep Med 2013; 2013: 610-632.
14. Akram A, Stevens RP, Konecny P. Photobacterium damselae and Vibrio harveyi hand infection from marine exposure. Med J Aust 2015; 203: 224-225.e1.
15. Chochlakis D, Varveraki SP, Kostalas DM, Carouzou CK, Psaroulaki A. Infection due to Vibrio harveyi and Photobacterium damselae following injury into a marine environment. Biomed J Sci & Tech Res 2019; 22: 16462-16466.
16. Sahu KK, Sherif AA, Davaro R. A Rare Cause of Cellulitis: Photobacterium damselae. J Microsc Ultrastruct 2020; 8: 25-26.
17. Schröttner P, Tille E, Lück C, Bunk B. Wound infection caused by Photobacterium damselae in a 33-year-old woman: case report and review of literature. GMS Infectious Diseases 2020; 8: Doc23.
18. Guimaraes D, Ribeiro L, Vieira L, Coelho R. Necrotizing fasciitis caused by Photobacterium damselae: the first case in Portugal. Acta Med Port 2021; 34: 615-618.
19. Hayano S, Masaki T, Tadakuma R, Kashima M. Photobacterium damselae subsp. damselae bacteraemia in a patient with liver cirrhosis. BMJ Case Reports CP 2021; 14: e242580.
20. Yuen KY, Ma L, Wong SS, Ng WF. Fatal necrotizing fasciitis due to Vibrio damsela. Scand J Infect Dis 1993; 25: 659-661.
21. Perez-Tirse J, Levine JF, Mecca M. Vibrio damsela. A cause of fulminant septicemia. Arch Intern Med 1993; 153: 1838-1840.
22. Shin JH, Shin MG, Suh SP, Ryang DW, Rew JS, Nolte FS. Primary Vibrio damsela septicemia. Clin Infect Dis 1996; 22: 856-857.
23. Fraser SL, Purcell BK, Delgado B Jr, Baker AE, Whelen AC. Rapidly fatal infection due to Photobacterium (Vibrio) damsela. Clin Infect Dis 1997; 25: 935-936.
24. Tang WM, Wong JW. Necrotizing fasciitis caused by Vibrio damsela. Orthopedics 1999; 22: 443-444.
25. Yamane K, Asato J, Kawade N, Takahashi H, Kimura B, Arakawa Y. Two cases of fatal necrotizing fasciitis caused by Photobacterium damsela in Japan. J Clin Microbiol 2004; 42: 1370-1372.
26. Asato J, Kanaya F. Fatal infection of the hand due to Photobacterium damsela: a case report. Clin Infect Dis 2004; 38: e100-101.
27. Goodell KH, Jordan MR, Graham R, Cassidy C, Nasraway SA. Rapidly advancing necrotizing fasciitis caused by Photobacterium (Vibrio) damsela: a hyper aggressive variant. Crit Care Med 2004; 32: 278-281.
28. Kim HR, Kim JW, Lee MK, Kim JG. Septicemia progressing to fatal hepatic dysfunction in an cirrhotic patient after oral ingestion of Photobacterium damsela: a case report. Infection 2009; 37: 555-556.
29. Martin DP, Barron OA, Wu CH. Photobacterium damsela necrotizing fasciitis of the arm. J Hand Surg Am 2021; 1: e1-e8.
30. Jana S, Deb JK. Molecular understanding of aminoglycoside action and resistance. Appl Microbiol Biotechnol 2006 M; 70: 140-150.
31. Nikajima Y. Mechanisms of bacterial resistance to macrolide antibiotics. J Infec Chemother 1999; 5: 61-74.