IDCases 5 (2016) 6–8

Contents lists available at ScienceDirect

IDCases

journal homepage: www.elsevier.com/locate/idcr

Case report

Serratia fonticola, pathogen or bystander? A case series and review of the literature

Abdullah Aljorayid [a], Roberto Viau [b,c], Laila Castellino [d,e], Robin L.P. Jump [c,f,*]

[a] Department of Medicine, University Hospitals Case Medical Center, Cleveland, OH, USA
[b] Medical Service, Louis Stokes Cleveland Veterans Affairs Medical Center (LSCVAMC), Cleveland, OH, USA
[c] Division of Infectious Diseases and HIV Medicine, Department of Medicine, Case Western Reserve University, Cleveland, OH, USA
[d] Dayton Veterans Affairs Medical Center, USA
[e] Wright State University, Boonshoft School of Medicine, Dayton, OH, USA
[f] Geriatric Research, Education and Clinical Center (GRECC), LSCVAMC, Cleveland, OH, USA

ARTICLE INFO

Article history:
Received 3 March 2016
Received in revised form 20 May 2016
Accepted 21 May 2016

Keywords:
Serratia fonticola
Enterobacteriaceae
Bacteremia
Urosepsis
Asymptomatic bacteriuria

ABSTRACT

Serratia fonticola is an unusual human pathogen, previously described primarily as causing skin and soft tissue infections following trauma. There is little information in the literature about its treatment or susceptibilities. We describe the case of a 67-year-old male with paraplegia who developed urosepsis due to *S. fonticola.* Blood and urine cultures obtained prior to the initiation of antimicrobials both grew *S. fonticola.* The patient completed a 15-day course of antimicrobials and had an uneventful recovery.

We reviewed 17 other patients with clinical cultures positive for *S. fonticola*. Of these, 11 isolates were from the genitourinary system, most often as part of a polymicrobial culture. The majority of the other organisms recovered were recognized pathogens from the *Enterobacteriaceae* family. The cases suggest that when recovered in conjunction with other organisms, *S. fonticola* does not lead to enhanced virulence or worse clinical outcomes and may be a bystander. When detected alone, which is a rare occurrence, *S. fonticola* may function as a human pathogen.

Introduction

First described by Gavini et al. in 1979, *Serratia fonticola* is a member of the *Enterobacteriaceae* family found in a wide array of environments, including drinking water, soil and sewage [1,2]. In 1985, Farmer et al. detailed biochemical identification of several *Enterobacteriaceae* organisms found among human specimens sent to the Centers for Disease Control and Prevention [3]. Specifically, they detected *S. fonticola* isolates among clinical samples obtained from wounds and respiratory tracts, but not urine, distinguishing them from other *Serratia* spp. based in part on the lack of extracellular DNase, gelatinase and lipase.

Only 5 case reports describe human *S. fonticola* infections. The first was a 73-year-old woman with a thigh abscess and bacteremia secondary to infected hardware placed following a car accident 5 months previously [4]. A second case was a 15-year-old male with delayed septic arthritis of his knee due to a retained foreign body following a bike accident [5]. Two more cases involved polymicrobial skin and soft tissue infections following trauma, while the fifth case was an immunocompromised male with diarrhea attributed to *S. fonticola* [6–8].

Here we present a case report of a patient who developed urosepsis due to *S. fonticola.* We conducted a retrospective review of clinical cultures that grew *S. fonticola* and reviewed prior literature, using the term "*Serratia fonticola*" to query PubMed. To the best of our knowledge, this is the first description of *S. fonticola* as a pathogen associated with the urinary tract.

Case report

A 67-year-old male sustained a combat injury in Vietnam resulting in T12 paraplegia. He relied upon assisted bowel care and a chronic indwelling urethral catheter to address his neurogenic bowel and bladder, respectively. Additional comorbidities included hypertension, sleep apnea, and syndrome of inappropriate antidiuretic hormone secretion (SIADH). Due to the deteriorating health of his primary caregiver, the patient agreed to placement in a Veterans Affairs long-term care ward specializing in residents with spinal cord injury. During his 4th month in the long-term ward, he reported anxiety, malaise and nausea with an episode of

* Corresponding author at: GRECC 111C(W), Louis Stokes Cleveland VA Medical Center, 10701 East Blvd., Cleveland, OH 44106, USA. Tel.: +1 216 791 3800x4788; fax: +1 216 229 2403.
E-mail address: robin.jump@va.gov (Robin L.P. Jump).

http://dx.doi.org/10.1016/j.idcr.2016.05.003

vomiting. He told the staff that he felt like he had a urinary tract infection and underwent a non-traumatic exchange of his indwelling urethral catheter. A urinalysis obtained from the new catheter showed clear yellow urine with 2+ bacteria, 3 red blood cells per high-powered field (hpf), 66 white blood cells (WBC) per hpf, WBC clumps, mucus and sediment.

Within 6 h following the catheter change, he developed a fever to 101.1°F accompanied by hypotension (97/65 mmHg). The staff observed he was exhibiting signs of mild delirium; his physical exam was otherwise at baseline. Laboratory values included a WBC count of 9.7×10^3 cells per mL with 75% neutrophils, <1% granulocytes and a creatinine of 0.8 mg/dL. Blood and urine cultures were obtained prior to the patient being empirically started on piperacillin/tazobactam. He also received supportive care measures, including intravenous fluids, antiemetics and antipyretics. Within 24 h, he defervesced and resumed normal oral intake.

Blood cultures grew *S. fonticola* and urine cultures grew >100,000 colony forming units per mL of *S. fonticola* and *Providencia stuartii.* The *S. fonticola* isolates were susceptible to ciprofloxacin, trimethoprim/sulfamethoxazole, cefepime, piperacillin/tazobactam and carbapenems and were resistant to ampicillin, cefazolin and ampicillin/sulbactam. Of note, the isolates were resistant to gentamicin but susceptible to amikacin. Following the availability of *S. fonticola* susceptibilities, he completed a total of 2 weeks of antimicrobials with oral ciprofloxacin and had an uneventful recovery.

Case series

Given the paucity of information about *S. fonticola* infections, we sought to more completely describe the range of clinical pathology associated with this organism. After obtaining approval from the Institutional Review Board at the authors' Veterans Affairs Medical Centers, we queried the microbiology database and identified an additional 17 patients from 1999 to 2015 with clinical cultures positive for *S. fonticola.* Table 1 summarizes these cases as well as the 5 previous case reports [9].

Two of the patients had polymicrobial bacteremia related to mucosal injury of the gut. Among 4 other patients, *S. fonticola* was one of several organisms recovered from superficial wound cultures. One of these was an elderly male with end-stage renal disease who developed a surgical site infection following placement of a fistula. Three others were diabetics with peripheral vascular disease and foot infections severe enough to warrant surgical debridement.

Notably, the remaining 11 cases were patients with urine cultures that grew *S. fonticola.* Only 3 of the 11 cultures grew *S. fonticola* alone, while the remaining 8 grew a variety of Gram-positive and Gram-negative bacteria. Of these 11 cases, 5 patients had clinical signs and symptoms consistent with urinary tract infections (UTIs), while the remaining 6 had asymptomatic bacteriuria. Among the 5 patients with UTIs, 2 had *S. fonticola* alone, while the remaining 3 had polymicrobial urine cultures. In this series of seventeen cases, the presence of *S. fonticola* did not appear to confer any increased virulence or distinct features. Table 2 details the antimicrobial susceptibilities of the *S. fonticola* isolates described above.

Table 2
Antimicrobial susceptibilities of *S. fonticola* isolates described in this report.

Antimicrobial	Number of isolates tested	Susceptible[a,b]
Ampicillin	18	0 (0%)
Ampicillin–sulbactam	15	4 (27%)
Piperacillin–tazobactam	14	13 (93%)
Cefazolin[c]	19	2 (11%)
Cefepime	14	14 (100%)
Ceftriaxone	10	9 (90%)
Ertapenem	9	9 (100%)
Imipenem	11	10 (91%)
Ciprofloxacin	18	14 (78%)
Levofloxacin	9	5 (78%)
Gentamicin	13	12 (93%)
Nitrofurantoin	11	1 (9%)
Trimethoprim–sulfamethoxazole	20	8 (40%)

[a] Number (percent).
[b] Unless otherwise noted, based on the European Committee on Antimicrobial Susceptibility Testing (EUCAST) Clinical breakpoints for bacteria v 6.0 [16].
[c] Based upon the 2014 Clinical and Laboratory Standards Institute breakpoints for uncomplicated urinary tract infections or blood, depending on the sample [17].

Discussion

To the best of our knowledge this is the second report of *S. fonticola* blood-stream infection in humans, and the third report of such an infection in a vertebrate [10]. Our retrospective medical record review identified an additional two patients who had *S. fonticola* bacteremia, though in those cases it was not the sole pathogen. Four previous case reports detail *S. fonticola* infections secondary to trauma. Farmer et al. found 13 species from clinical specimens (11 from wound cultures, 2 from the respiratory tract) while Stock et al. assessed 6 clinical specimens, reporting only one from urine and another one from a bloodstream infection (with no description of clinical details) [3,11].

Given that the majority of *S. fonticola* isolates in our medical system came from urine cultures, we postulate that this organism may be part of the microbiota inhabiting the gastrointestinal tract. This is supported by the 2 cases of polymicrobial bacteremia in patients with injury of their intestinal mucosa. It is surprising that no prior reports of *S. fonticola* in urinary specimens exist, which raises the possibility that this organism may only be an occasional member of the gastrointestinal microbiota. Van Hoek et al.

Table 1
Summary of *Serratia fonticola* cases described in the literature and in this report.

Clinical syndrome[a]	Cases reported	Cultures with *S. fonticola* only	Cases with polymicrobial cultures		References
			Gram-positive cocci	Gram-negative rods[b]	
Bacteremia	4	2	1	1	This report and [4]
Skin and soft tissue infection	7	1	6	6	This report and [5–7]
Urinary tract infection[e,d]	5	2	1	3	This report
Asymptomatic bacteriuria[c,d]	6	1	3	3	This report
Diarrhea	1	1[e]	–	–	[8]

[a] Most severe clinical syndrome reported (*i.e.*, a patient with bacteremia and urinary tract infection is reported only as bacteremia).
[b] Other than *S. fonticola*.
[c] Determination of whether the positive urine culture represented a urinary tract infection or asymptomatic bacteriuria was made using the criteria detailed by Hooten et al. [14] and Loeb et al. [15] for patients with and without indwelling urinary catheters, respectively.
[d] Includes 1 patient with a nephrostomy tube(s).
[e] Sole organism isolated on selective media.

detected *S. fonticola* on a variety of retail vegetables, suggesting ample opportunities for exposure, including through ingestion [12]. Prior reports on wounds and respiratory tracts, nevertheless, are rare enough to question how often humans are truly colonized by this organism.

While human infections described so far have not presented a therapeutic challenge in terms of resistance, *S. fonticola* has the potential of harboring resistance elements, including a chromosomal inducible AmpC beta-lactamase. Van Hoek et al. found an inducible FONA-type extended spectrum beta-lactamase (ESBL) associated with resistance to third generation cephalosporins in isolates from retail vegetables [12]. While a chromosomal enzyme in *S. fonticola*, the same ESBL exists on a self-transferrable plasmid in *Enterobacter cloacae* [13]. There is a theoretical risk that *S. fonticola* could transmit these resistance elements to other bacteria. The antimicrobial susceptibility data from our clinical specimens, as well as previous reports, indicate that extended-spectrum cephalosporins, carbapenems and fluoroquinolones are the best options for empiric treatment of true *S. fonticola* infections.

Based upon this case series of clinical cultures from our medical system, *S. fonticola* appears to remain an unusual human pathogen and is more commonly a bystander in polymicrobial infections than previously appreciated.

Ethical disclosures

The Institutional Review Board at the corresponding author's institution approved the case series.

Conflict of interest

All authors declare they have no conflicts of interest relevant to this work.

Acknowledgements

This work was supported by funds and facilities provided by the Veterans Health Administration (RV, LC, RJ) and the Geriatric Research Education and Clinical Centers (GRECC) in Veterans Integrated Service Network-10 (RJ). The contents do not represent the views of the Department of Veterans Affairs or the United States Government. RJ gratefully acknowledges the T. Franklin Williams Scholarship with funding provided by Atlantic Philanthropies, Inc., the John A. Hartford Foundation, the Association of Specialty Professors, the Infectious Diseases Society of America and the National Foundation for Infectious Diseases.

References

[1] Gavini F, Ferragut C, Izard D, Trinel PA, Leclerc H, Lefebvre B, et al. *Serratia fonticola*, a new species from water. Int J Syst Evol Microbiol 1979;29:92–101. http://dx.doi.org/10.1099/00207713-29-2-92.

[2] Tasic S, Obradovic D, Tasic I. Characterization of *Serratia fonticola*, an opportunistic pathogen isolated from drinking water. Arch Biol Sci 2013;65:899–904. http://dx.doi.org/10.2298/ABS1303899T.

[3] Farmer JJ, Davis BR, Hickman-Brenner FW, McWhorter A, Huntley-Carter GP, Asbury MA, et al. Biochemical identification of new species and biogroups of *Enterobacteriaceae* isolated from clinical specimens. J Clin Microbiol 1985;21:46–76.

[4] Bollet C, Gainnier M, Sainty JM, Orhesser P, Micco PD. *Serratia fonticola* isolated from a leg abscess. J Clin Microbiol 1991;29:834–5.

[5] Gorret J, Julie G, Chevalier J, Julie C, Gaschet A, Anne G, et al. Childhood delayed septic arthritis of the knee caused by *Serratia fonticola*. Knee 2009;16:512–4. http://dx.doi.org/10.1016/j.knee.2009.02.008.

[6] Pfyffer GE. *Serratia fonticola* as an infectious agent. Eur J Clin Microbiol Infect Dis 1992;11:199–200. http://dx.doi.org/10.1007/BF01967080.

[7] Kunimoto D, Rennie R, Citron DM, Goldstein EJC. Bacteriology of a bear bite wound to a human: case report. J Clin Microbiol 2004;42:3374–6. http://dx.doi.org/10.1128/JCM.42.7.3374-3376.2004.

[8] Soler C, Samson T, Hernandez E, Hervé V, De Revel T. *Serratia fonticola*, germe opportuniste: à propos d'une observation chez un immunodéprimé. Médecine et Maladies Infectieuses 2000;30:599–600. http://dx.doi.org/10.1016/S0399-077X(00)80029-3.

[9] Mahlen SD. Serratia infections: from military experiments to current practice. Clin Microbiol Rev 2011;24:755–91. http://dx.doi.org/10.1128/CMR.00017-11.

[10] Garcia ME, Lanzarot P, Costas E, Lopez Rodas V, Marín M, Blanco JL. Isolation of *Serratia fonticola* from skin lesions in a Nile Crocodile (*Crocodylus niloticus*) with an associated septicaemia. Vet J 2008;176:254–6. http://dx.doi.org/10.1016/j.tvjl.2007.02.025.

[11] Stock I, Burak S, Sherwood KJ, Grüger T, Wiedemann B. Natural antimicrobial susceptibilities of strains of "unusual" Serratia species: *S. ficaria*, *S. fonticola*, *S. odorifera*, *S. plymuthica and S. rubidaea*. J Antimicrob Chemother 2003;51:865–85. http://dx.doi.org/10.1093/jac/dkg156.

[12] van Hoek AHAM, Veenman C, van Overbeek WM, Lynch G, de Roda Husman AM, Blaak H. Prevalence and characterization of ESBL- and AmpC-producing *Enterobacteriaceae* on retail vegetables. Int J Food Microbiol 2015;204:1–8. http://dx.doi.org/10.1016/j.ijfoodmicro.2015.03.014.

[13] Naas T, Poirel L, Nordmann P. Minor extended-spectrum β-lactamases. Clin Microbiol Infect 2008;14(Suppl. 1):42–52. http://dx.doi.org/10.1111/j.1469-0691.2007.01861.x.

[14] Hooton TM, Bradley SF, Cardenas DD, Colgan R, Geerlings SE, Rice JC, et al. Diagnosis, prevention, and treatment of catheter-associated urinary tract infection in adults: 2009 International Clinical Practice Guidelines from the Infectious Diseases Society of America. Clin Infect Dis 2010;50:625–63.

[15] Loeb M, Bentley DW, Bradley S, Crossley K, Garibaldi R, Gantz N, et al. Development of minimum criteria for the initiation of antibiotics in residents of long-term-care facilities: results of a consensus conference. Infect Control Hosp Epidemiol 2001;22:120–4. http://dx.doi.org/10.1086/501875.

[16] EUCAST: clinical breakpoints. http://www.eucast.org/clinical_breakpoints/ [accessed 22.01.16].

[17] Clinical & Laboratory Standards Institute: CLSI guidelines. http://clsi.org/ [accessed 22.01.16].