JCM
Journals.ASM.org

A Fishy Tale: a Man with Empyema Caused by *Streptococcus halichoeri*

Rui Min Foo,[a] Douglas Chan[b]

Department of Infectious Disease, National University Hospital, Singapore[a]; Department of Microbiology, National University Hospital, Singapore[b]

In 2004, veterinary laboratories in the United Kingdom reported a novel Lancefield group B streptococcus, *Streptococcus halichoeri*, in seals. We report a case of *Streptococcus halichoeri* causing postoperative empyema in a patient. A search of the literature revealed that this is the first case of *S. halichoeri* ever reported in humans.

CASE REPORT

Our patient was a 45-year-old Chinese male who presented with sharp left-sided chest pain in October 2012. He was referred to a tertiary hospital center by a family physician for a left third rib lesion seen on his chest radiograph. He was otherwise asymptomatic, with no significant cough or loss of weight. He had a past medical history of diabetes mellitus, hypertension, and hyperlipidemia. He worked as a supervisor in a chemical factory and kept a pet fish at home. His physical examination was unremarkable. Computed tomography (CT) of the thorax reported a diffusely expanded lesion in the body of the left third rib with endosteal scalloping of the cortex and soft tissue attenuation internally and septations within the lesion. This appeared longstanding and was suggestive of a benign process. There was also an 8-mm lucency with sclerotic margins seen in the left fifth rib. A full-body positron emission tomography (PET) scan revealed an expanded lytic lesion in the left 3rd rib with cortical disruption. Preoperative laboratory tests showed a white blood cell (WBC) count of 11.9×10^9/liter, with a neutrophil count of 8.6×10^9/liter.

He underwent an elective left thoracotomy and excision biopsy of the left third rib lesion in March 2013 and had a left chest tube inserted intraoperatively. Histology reported a benign osteofibrous lesion compatible with fibrous dysplasia. Three days after his surgery, he developed a fever with cough. He had persistent hemoserous drainage from the chest tube. Inflammatory markers were elevated: a WBC count of 17×10^9/liter and a C-reactive protein (CRP) concentration of 271 mg/liter.

Pleural fluid sent for Gram staining and bacterial culture revealed numerous neutrophils and Gram-positive cocci in chains. After 24 h of incubation on sheep blood agar, tiny white nonhemolytic colonies were isolated. The organism was unidentifiable by the Vitek 2 system (bioMérieux) or by the API Streptococcal commercial kit (API 20 STREP; bioMérieux SA, Marcy l'Etoile, France). Sequencing of the 16S rRNA gene also failed to yield a result. Lancefield grouping saw this organism as belonging to Lancefield group B. Acid was produced from mannitol and ribose but not from L-arabinose, glycogen, inulin, raffinose, sorbitol, or trehalose. The organism produced arginine dihydrolase and acetoin, but no activity was detected for α-galactosidase, β-galactosidase, or α-glucuronidase. It also did not hydrolyze hippurate. We subjected it to matrix-assisted laser desorption ionization, using the Bruker Biotyper system with the version 3.1 software and database, and this gave a score of 2.227 for *Streptococcus halichoeri*. The organism was sensitive to penicillin (MIC, 0.016 mg/liter) and levofloxacin (MIC, 0.5 mg/liter).

The patient recalled handling large freshwater fish (flowerhorn cichlids, also known as *luo han*) and washing large styrofoam boxes containing the fish from a local fish farm a week prior to his admission. During his hospital stay, his fish, boxes, and fish tank had been discarded.

He was started on oral levofloxacin in view of a possible previous drug allergy to ampicillin. After a week of levofloxacin treatment, his WBC count remained elevated, and a repeat CT thorax showed a left loculated pleural effusion with compressive atelectasis of the adjacent left lower lobe. A second chest drain was inserted under radiological guidance on postoperative day 11. Repeated pleural fluid cultures persistently grew *Streptococcus halichoeri*. Intravenous ceftriaxone at 2 g daily was commenced after 10 days of levofloxacin. Chest tube pleural fluid drainage improved significantly, and his inflammatory markers trended downwards with ceftriaxone. He received a total of 4 weeks of intravenous ceftriaxone with no recurrence of pleural effusion on outpatient follow-up.

Zoonotic infections caused by *Streptococcus* species have been a gradual but growing concern for emerging infections, with a few outbreaks in recent years. The major species include *Streptococcus canis*, *Streptococcus equi* subsp. *zooepidemicus*, *Streptococcus iniae*, and *Streptococcus suis* (1).

Streptococcus suis is a major porcine pathogen and is the most commonly isolated bacterium in tonsils of swine (2). It has been increasingly recognized as an emerging zoonotic pathogen, especially in Asia. *S. suis* can be transmitted to human beings via direct contact, usually in people who handle or eat pork. *S. suis* has been reported to cause bacterial meningitis in a patient who worked as a butcher (3) and another after a swine bite (4), as well as endocarditis in three patients who had a history of undercooked pork

Received 4 November 2013 **Accepted** 6 November 2013
Published ahead of print 13 November 2013
Editor: G. V. Doern
Address correspondence to Foo Rui Min, rui_min_foo@nuhs.edu.sg.

doi:10.1128/JCM.03055-13

consumption (5), streptococcal toxic shock syndrome (6), and pneumonia and empyema (7).

Streptococcus iniae is a serious aquatic pathogen that rarely infects humans, causing outbreaks and mortality in wild reef fish (8) and farmed marine aquaculture. It was first reported to cause invasive human infections in 1995, affecting nine patients, of which 8 had hand cellulitis, one with endocarditis, meningitis, and arthritis (9). Since then, there have been reports of *Streptococcus iniae* causing soft tissue infection in humans resulting from fresh seafood contact in Taiwan (10), with two reports of osteomyelitis and discitis (11, 12).

While common pathogens causing human infection acquired from tropical fishes through open wounds include *Mycobacterium marinum*, *Streptococcus iniae*, *Vibrio vulnificus*, *Vibrio damsela*, *Aeromonas hydrophila*, *Edwardsiella tarda*, and *Erysipelothrix rhusiopathiae* (13), *Streptococcus halichoeri* has not been known to be a problem in humans.

Streptococcus halichoeri was first reported in seals in the United Kingdom in Inverness and Cornwall veterinary laboratories in 2004, having been isolated from wounds on gray seals that had been inflicted by other seals. Hence, it was hypothesized that the organism could be present on the teeth and skin of gray seals. Although there was no evidence of human infections with the organism, an alert was published in the United Kingdom's Communicable Disease Report informing health care workers to consider *S. halichoeri* in cases of seal bites (14).

It remains an open question if the patient's recent fish contact is a possible source of his *Streptococcus halichoeri* infection.

Routine methods used in the microbiology laboratory may not identify *S. halichoeri*. Commonly used identification systems, such as API 20 Strep (bioMérieux) or Vitek 2 (bioMérieux), are unable to identify this organism as it is not included in their database.

We found that 16S rRNA gene sequencing was not helpful in this case but were pleasantly surprised that matrix-assisted laser desorption ionization–time of flight mass spectrometry (MALDI-TOF MS) was able to identify this organism with such a good score. Since this was the first time our laboratory had isolated such an organism, we proceeded to perform a variety of biochemical tests to confirm the identity of the organism. *S. halichoeri* is a non-beta-hemolytic Lancefield group B streptococcus and produces acid from cyclodextrin, mannitol, maltose, ribose, and pullulan. The organism is also Voges-Proskauer positive and shows activity for arginine dihydrolase, alkaline phosphatase, and pyrrolidonyl arylamidase (15).

Since not all laboratories may have the capability of MALDI-TOF MS, they will need to rely on conventional tests to pick up cases of *S. halichoeri*. One indication that the laboratory might have isolated a strain of *S. halichoeri* is that, like *Streptococcus agalactiae*, *S. halichoeri* is a Lancefield group B streptococcus. However, unlike *S. agalactiae*, it is non-beta-hemolytic and does not hydrolyze hippurate. Such a finding can then trigger further testing with the above biochemical tests to confirm if one is dealing with *S. halichoeri*.

This is the first case of *Streptococcus halichoeri* found in humans. However, it could be underdiagnosed, depending on the individual laboratory's identification methods. A detailed history of contact with fish and marine animals should be obtained in all cases of infection caused by this organism to determine if *Streptococcus halichoeri* could potentially be an emerging zoonotic infection.

REFERENCES

1. **Fulde M, Valentin-Weigand P.** 2013. Epidemiology and pathogenicity of zoonotic streptococci. Curr. Top. Microbiol. Immunol. **368:**49–81. http://dx.doi.org/10.1007/82_2012_277.
2. **O'Sullivan T, Friendship R, Blackwell T, Pearl D, McEwen B, Carman Slaviæ SD, Dewey C.** 2011. Microbiological identification and analysis of swine tonsils collected from carcasses at slaughter. Can. J. Vet. Res. **75:** 106–111. http://www.canadianveterinarians.net/publications/canadian-journal-veterinary-research.aspx#.Up4pRydok1c.
3. **Zalas-Wiecek P, Michalska A, Grabczewska E, Olczak A, Pawlowska M, Gospodarek E.** 2013. Human meningitis caused by Streptococcus suis. J. Med. Microbiol. **62:**483–485. http://dx.doi.org/10.1099/jmm.0.046599-0.
4. **Mori K, Ishii N, Mochizuki H, Taniguchi A, Shiomi K, Nakazato M.** 2013. Bilateral sensorineural hearing impairment due to Streptococcus suis meningitis 20 days after swine bite. Rinsho Shinkeigaku **53:**732–735. http://dx.doi.org/10.5692/clinicalneurol.53.732.
5. **Pachirat O, Taksinachanekit S, Mootsikapun P, Kerdsin.** 2012. Human Streptococcus suis endocarditis: echocardiographic features and clinical outcome. Clin. Med. Insights Cardiol. **6:**119–123. http://dx.doi.org/10.4137/CMC.S9793.
6. **Chen C, Tang J, Dong W, Wang C, Feng Y, Wang J, Zheng F, Pan X, Liu D, Li M, Song Y, Zhu X, Sun H, Feng T, Guo Z, Ju A, Ge J, Dong Y, Sun W, Jiang Y, Wang J, Yan J, Yang H, Wang X, Gao GF, Yang R, Wang J, Yu J.** 2007. A glimpse of streptococcal toxic shock syndrome from comparative genomics of S. suis 2 Chinese isolates. PLoS One **2:**e315. http://dx.doi.org/10.1371/journal.pone.0000315.
7. **Oh YJ, Song SH.** 2012. A Case of Streptococcus suis infection causing pneumonia with empyema in Korea. Tuberc. Respir. Dis. (Seoul) **73:**178–181. http://dx.doi.org/10.4046/trd.2012.73.3.178.
8. **Keirstead ND, Brake JW, Griffin MJ, Halliday-Simmonds I, Thrall MA, Soto E.** 27 September 2013. Fatal septicemia caused by the zoonotic bacterium Streptococcus iniae during an outbreak in Caribbean reef fish. Vet. Pathol. http://dx.doi.org/10.1177/0300985813505876.
9. **Weinstein MR, Litt M, Kertesz DA, Wyper P, Rose D, Coulter M, McGeer A, Facklam R, Ostach C, Willey BM, Borczyk A, Low DE.** 1997. Invasive infections due to a fish pathogen, Streptococcus iniae. S. iniae Study Group. N. Engl. J. Med. **337:**589–594.
10. **Koh TH, Sng LH, Yuen SM, Thomas CK, Tan PL, Tan SH, Wong NS.** 2009. Streptococcal cellulitis following preparation of fresh raw seafood. Zoonoses Public Health **56:**206–208. http://dx.doi.org/10.1111/j.1863-2378.2008.01213.x.
11. **Koh TH, Kurup A, Chen J.** 2004. Streptococcus iniae discitis in Singapore. Emerg. Infect. Dis. **10:**1694–1696. http://dx.doi.org/10.3201/eid1009.040029.
12. **Lau SK, Woo PC, Tse H, Leung KW, Wong SS, Yuen KY.** 2003. Invasive *Streptococcus iniae* infections outside North America. J. Clin. Microbiol. **41:**1004–1009. http://dx.doi.org/10.1128/JCM.41.3.1004-1009.2003.
13. **Lehane L, Rawlin GT.** 2000. Topically acquired bacterial zoonoses from fish: a review. Med. J. Aust. **173:**256–259.
14. 2008. The Human Animal Infections and Risk Surveillance (HAIRS) Group, first report 2004–2007. Health Protection Agency, Public Health England, Colindale, United Kingdom.
15. **Lawson P, Collins M.** 2004. Streptococcus halichoeri sp. nov., isolated from grey seals (Halichoerus grypus) Int. J. Syst. Evol. Microbiol. **54:** 1753–1756. http://dx.doi.org/10.1099/ijs.0.63082-0.