Case study

**Pig’s ear: Streptococcus suis** Meningitis and its associated inner ear implications

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**A R T I C L E   I N F O**

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Zoonosis
Vestibular areflexia

**A B S T R A C T**

Streptococcus suis (S. suis) is a zoonotic pathogen commonly found in Asian countries. Infection with this bacterium typically clinically presents as meningitis and individuals whom handle swine are at increased risk of developing infections.

We present a case of a patient with a S. suis meningitis who worked as a butcher. The 48-year-old man was admitted to our department with headaches, fevers, nausea and bilateral hearing loss. According to his medical history, the patient had sustained a cut on his finger while preparing pork meat. A microbiological examination of the cerebrospinal fluid and blood revealed S. suis. The patient was empirically treated with ceftriaxone, vancomycin and dexamethasone. The patient made a complete recovery from the meningitic process and in-

**Introduction**

Bacterial meningitis is a highly aggressive infectious process which has an associated high rate of morbidity and mortality. The four most common responsible agents are *Haemophilus influenzae*, *Streptococcus pneumoniae*, *Neisseria meningitidis* and *Listeria monocytogenes*. *Streptococcus suis*, a Gram-positive facultative coccus, is a pathogen with its natural habitat residing in pigs. Infection in humans with this bacterium typically causes a wide range of diseases including pneumonia, endocarditis, uveitis, spondylodiscitis and sepsis, which usually occurs following contact with swine. This is a particular occupational hazard for butchers and abattoir workers, especially in individuals whom have skin cuts or abrasions. The first description of human *S. suis* infection was described in Denmark in 1968 [1]. Since then, more than 900 cases have been reported worldwide [2].

**Case report**

A 48-year-old butcher, previously healthy male, was admitted to the emergency neurology department presenting with headaches, fevers and nausea for the past 24 h. The medical history was nonspecific, except that he had injured his foot with a knife at work 5 days previously. At admission, he had body temperature of 38.9°, a pulse rate of 115 beats/min, a blood pressure of 132/83 mmHg, and a respiration rate of 20 min/min. Although he was alert and oriented, physical examination revealed neck stiffness and gait ataxia. There was no other neurological signs or skin abnormalities.

Routine laboratory tests revealed a leukocyte count of \(10.42 \times 10^3/mm^3\) with 79.2% neutrophils and a C-reactive protein level of 50.72 mg/dL. Based on these results, we performed serologic tests for syphilis and human immunodeficiency virus in addition to brain computed-tomography scan, which were all negative. A lumbar puncture was performed and the cerebrospinal fluid (CSF) had a turbid color, a high opening pressure (250 mmH2O), an increased protein level and a decreased glucose level. After establishment of these tests results, the patient was immediately started on both vancomycin and ceftriaxone in order to empirically treat bacterial meningitis.

A subsequent culture and microbiological examination of the CSF and blood positively identified *S. suis* infection.

Two days after admission, the patient started complaining of sudden hearing loss and pronounced dizziness. Audiology carried out 4 and 15 days after admission revealed bilateral profound sensorineural hearing loss.

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hearing loss, especially at the high frequencies (Fig. 1A). The clinical head impulse test was bilaterally positive suggesting bilateral vestibular loss. This was confirmed 4 weeks post-admission with caloric testing (Fig. 1B). We placed the patient on steroid treatment with dexamethasone (at day 4) to help with the meningeal inflammation and hearing impairment. After completion of 14-day course of antimicrobial therapy, the patient made a complete recovery of the meningitis and inflammatory markers. However, the hearing and vestibular loss persisted.

Magnetic resonance imaging (MRI) performed 15 days after

![Figure 1](image1.png)

Fig. 1. A) Right (i) and left (ii) audiogram revealing bilateral profound sensorineural hearing loss. B) Videonystagmography recording revealing a bilateral areflexia. C) Brain MRE: axial T2 weighted (i) and gadolinium-enhanced (ii) images showing no abnormalities in the inner ear and brain parenchyma.
admission revealed no structural abnormalities (Fig. 1C). The patient was discharged in a stable condition after completion of a 3-week treatment. The patient was referred for elective surgery to have a right cochlear implant, 7 weeks after the presentation. This implant was not a success with respect to hearing improvement and the patient also responded poorly to vestibular rehabilitation, leaving him with considerable residual functional impairment.

Discussion

*S. suis* is a gram-positive facultative coccus often misidentified or undiagnosed. Human *S. suis* infection is mostly acquired through occupational or household exposure to contaminated pigs or pig meat. Most reports occur in south Asian countries (China, Thailand, Vietnam and Japan) [3] due to a large amount of pig-farming industries and high contact with pigs or raw pork in these countries. Our reported patient was healthy, and did not have other predisposing factors, such as asplenia, diabetes mellitus, alcoholism or malignancies [4]. *S. suis* was identified in the CSF and blood cultures in our patient. Molecular techniques with PCR have improved the rate of detection of *S. suis*. Furthermore, he had no signs of sepsis, which is the second-most-common manifestation and a major cause of *S. suis*-related death.

Hearing loss early during the course of the meningitis, usually sensorineural in the high-frequency range, leads to deafness in more than one-half of patients, as in our case. The deafness is usually severe, bilateral and may be accompanied by tinnitus, and in the majority of cases the hearing loss is permanent [5]. In some, as with our patient, vestibular loss can also occur. Hemorrhagic labyrinthitis, which is evident on MRI, was recently suggested as the cause of deafness in patients with *S. suis* meningitis [6]. *S. suis* is believed to enter the perilymph via the cochlear aqueduct through the lytic action of exotoxins. However, in our patient, we could not establish any discernable changes in cochlea or vestibule structures on examination of the MRI.

The treatment course for *S. suis* meningitis are the same for any other cause of bacterial meningitis. Previous studies have demonstrated that *S. suis* is susceptible to penicillin, ceftriaxone and vancomycin given in the same treatment dose and duration that is used for pneumococcal meningitis. *S. suis* meningitis usually responds very well to treatment with large doses of intravenous and typically after 24 h of treatment, the fever, headache and neck stiffness often resolve but hearing and vestibular complaints are usually permanent. Such patients should immediately receive hearing and vestibular rehabilitation to improve their independence in daily activities.

To conclude, accurate and quick diagnosis and early antimicrobial treatment are the most important factors in reducing functional impairment following *S. suis* infection. Therefore, in patients with meningitis and characteristic features such as hearing loss, *S. suis* should be considered especially in the context of an occupational hazard. Currently, there is no human *S. suis* vaccine. Pig vaccination and improvement of pig-raising conditions are effective methods to reduce the risk of human infection. Furthermore, educating high-risk population, increasing awareness, also helps to avoid human infection.

Conflicts of interest

The authors have no financial conflicts of interest

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