Case Report

Third Case of *Streptococcus suis* Infection in Greece

Marianneta Chatzopoulou, Ioanna Voulgaridou, Dimitrios Papalas, Petros Vasiliiou, and Maria Tsiakalou

Department of Clinical Microbiology, General Hospital of Larissa, 41221 Larissa, Greece

Correspondence should be addressed to Marianneta Chatzopoulou; mariannetachatz@gmail.com

Received 24 July 2015; Accepted 1 September 2015

Academic Editor: Larry M. Bush

Copyright © 2015 Marianneta Chatzopoulou et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

*Streptococcus suis* is a facultative anaerobic, Gram-positive coccus that can cause severe disease to both pigs and humans. Its zoonotic potential was first recognized in 1968 when the first human case of meningitis was reported in Denmark. Since then, over 1600 human cases have been reported worldwide the vast majority of which originated in Southeast Asia, and, thus, *S. suis* has been fairly characterized as an emerging pathogen. Infection in humans presents most commonly as bacteremia and/or meningitis while less common clinical manifestations such as endocarditis and septic arthritis can occur. *S. suis* infection is extremely uncommon in Greece and this is the third human case to be reported. Correct identification is of importance for optimization of antimicrobial treatment and epidemiological monitoring.

1. Introduction

*Streptococcus suis* is a facultative anaerobic, Gram-positive coccus that constitutes an opportunistic pathogen for pneumonia but a primary agent of sepsis and meningitis in pigs [1]. Its zoonotic potential was first recognized in 1968 [2] when the first human cases of meningitis were reported in Denmark. Since then, over 1600 human cases have been reported worldwide the vast majority of which originated in Southeast Asia and, thus, *S. suis* has been fairly characterized as an emerging pathogen. Infection in humans presents most commonly as bacteremia and/or meningitis while less common clinical manifestations such as endocarditis and purulent arthritis can occur. *S. suis* infection is extremely uncommon in Greece and this is the third human case to be reported [4, 5].

2. Case Presentation

A 34-year-old male patient presented to the ER department with a three-day history of malaise, fever, chills, and headache not responding to paracetamol. The patient was an immigrant of Indian ethnicity working at a local pigery. He did not report any recent travels abroad, had a free medical record, and did not abuse alcohol. The patient’s main clinical and laboratory findings on admission included fever (39°C), neck stiffness, partial unilateral hearing loss, leukocytosis (17400 WBCs/μL), polymorphonuclear type (93.8%), normocytic anemia (Hb 11.5 gr/dL), abnormal liver function values (SGOT 54 IU/L, SGPT 62 IU/L, total bilirubin 1.62 mg/dL, and direct bilirubin 0.72 mg/dL), and increased inflammation markers (fibrinogen 890 mg/dL, CRP 30.7 mg/dL, ferritin 879.3 mg/mL, erythrocyte sedimentation rate 115 mm, and PCT 2.58 ng/mL). There were no evident abnormal signs from the cardiovascular and pulmonary systems. Brain imaging that followed showed no abnormal findings. Thereafter, a lumbar puncture was performed and urine and blood samples were collected and sent for culture. In addition, examination of a blood smear and a malaria rapid antigen test were ordered to exclude cerebral malaria. Examination of the cerebrospinal fluid revealed increased cell number (476/μL) with polymorphonuclears as the predominant population (95%), low glucose levels (1 mg/dL), and high levels of protein (213 mg/dL). Gram stain of the specimen revealed the presence of Gram-positive bacteria with a somewhat coccoid shape (Figure 1). The clinicians were informed and empiric treatment with vancomycin and ceftriaxone was initiated while subsequent culture in the presence of
optochin discs followed. After 24 hours of incubation the cul-
ture revealed small α-hemolytic, optochin-resistant, catalase-
negative colonies growing on 5% sheep blood agar and
chocolate agar. On the same day, the blood culture turned
positive showing morphologically similar bacteria on Gram
stain. Identification and susceptibility testing were performed
with Vitek 2 Automated system. S. suis was identified as the
responsible pathogen in both cerebrospinal fluid and blood
cultures on days 3 and 4, respectively. The strain was tested
susceptible to beta-lactams, macrolides, and quinolones but
resistant to tetracycline (MIC > 16 μg/mL). Patient’s condition
improved dramatically since day 3 and deescalation of treat-
ment was decided [6] with vancomycin being discontinued
on the basis of the susceptibility report. The patient was
discharged a week later with persistent, unilateral, partial
hearing loss and was followed up on an out-patient basis.

3. Discussion

Streptococcus suis is a zoonotic pathogen that can cause severe
disease to both pigs and humans. The most common clinical
manifestations in humans are bacteremia and/or septicemia,
meningitis, endocarditis, purulent arthritis, endphalmitis, and
spondylodiscitis [7], while pneumonia has, also, been
reported [8]. S. suis has been characterized as an emerging
pathogen. Whether this is a result of improved diagnostics or
changing epidemiological characteristics is not clear [9].
The spatial distribution of disease is, however, remarkably
distinct in different areas. Human infection is quite common
is Southeast Asia, less common in north Europe, rare in
North America, and virtually absent from Russia [10] despite
the well-developed pig-rearing industry of the latter. This
has been partially attributed to variations in prevalence of
serotype 2 strains between different regions and continents
[10] which are regarded as the most virulent. In addition,
different sequence types of serotype 2 strains prevail within
different geographic areas with ST1 being most prevalent in
Asia and ST25 and ST28 in North America [11]. The well-
recognized behavioral risk factors for infection are occu-
pational exposure to swine, consumption of contaminated
pork food, and physical contact with pigs in the presence of
skin injuries [12]. Males have a mean fourfold relative risk
to present with disseminated disease which, also, increases
with age [12]. Some studies have shown an association with
alcoholism and diabetes mellitus [7] but this is not a con-
sistent finding [12]. Nevertheless, the exact human-pathogen
interactions that lead to disseminated infection have yet to be
elucidated [13] and there are studies that indicate that humans
can act as asymptomatic carriers [10]. As far as we know this
is the third case reported in Greece over a ten-year period
since the first case report in 2005 [4, 5]. Our patient definitely
belonged to a high-risk group for infection due to his
occupational exposure to swine. He was of Indian ethnicity,
had no underlying comorbidities, and did not report alcohol
abuse.

Streptococcus suis is an ovoid-shaped Gram-positive coc-
cus that forms short chains and can be easily misidentified
for either Streptococcus pneumoniae or Enterococcus spp.
Correct identification, which can be rather tricky especially
in low prevalence settings, is of clinical importance for several
reasons, the first of which is the need for optimization of
antimicrobial therapy. S. suis strains are generally suscep-
tible to beta-lactams [14] while enterococci show variable
susceptibility to ampicillin and are considered intrinsically
resistant to cephalosporins [15]. Pneumococcal resistance
to beta-lactams is, also, very common [15]. On the other
hand, S. suis strains show a high frequency of resistance to
tetracyclines and macrolides [14, 16] which are frequently
prescribed against pneumococcal infections [17]. In our case,
the isolate was tested resistant to tetracycline but susceptible
to erythromycin. Furthermore, correct identification is of
public health importance. S. suis infection can be foodborne
and while the pathogen is usually responsible for the occur-
rence of sporadic cases outbreaks have been reported in the
literature as well [18]. It is, therefore, important to investigate
and elucidate the likely source of infection. Conclusively, it
is important to record the cases in order to monitor the
epidemiological trends of disease in spatial and temporal
terms. It is worth mentioning that S. suis is not a notifiable
pathogen and surveillance relies only on unstructured data.

In summary of the above, Streptococcus suis should always
be included in differential diagnosis of systemic infections
even in low prevalence settings such as Greece. Clinical
suspicion should be raised when the patients report a history
of high-risk behavior up to two weeks prior to the onset of
symptoms or when symptoms consistent with meningitis are
accompanied by hearing loss [19]. Correct identification is of
importance for reasons such as optimization of antimicrobial
treatment and epidemiological monitoring.

Conflict of Interests

The authors declare that there is no conflict of interests
regarding the publication of this paper.

References

[1] S. Wang, M. Gao, T. An et al., “Genetic diversity and virulence
of novel sequence types of Streptococcus suis from diseased and
healthy pigs in China,” Frontiers in Microbiology, vol. 6, article
173, 2015.
[2] B. Perch, P. Kristjansen, and K. Skadhauge, “Group R streptococci pathogenic for man: two cases of meningitis and one fatal case of sepsis,” *Acta Pathologica et Microbiologica Scandinavica*, vol. 74, no. 1, pp. 69–76, 1968.

[3] V. T. L. Huong, N. Ha, N. T. Huy et al., “Epidemiology, clinical manifestations, and outcomes of *Streptococcus suis* infection in humans,” *Emerging Infectious Diseases*, vol. 20, no. 7, pp. 1105–1114, 2014.

[4] I. A. Voutsadakis, “*Streptococcus suis* endocarditis and colon carcinoma: a case report,” *Clinical Colorectal Cancer*, vol. 6, no. 3, pp. 226–228, 2006.

[5] E. E. Mazokopakis, D. P. Kofteridis, J. A. Papadakis, A. H. Gikas, and G. J. Samonis, “First case report of *Streptococcus suis* septicemia and meningitis from Greece,” *European Journal of Neurology*, vol. 12, no. 6, pp. 487–489, 2005.

[6] Bacterial Meningitis(1).pdf, http://www.idsociety.org/uploaded-Files/IDSA/Guidelines-Patient Care/PDF_Library/Bacterial Meningitis(1).pdf.

[7] V. T. L. Huong, N. Ha, and N. T. Huy, “Epidemiology, clinical manifestations, and outcomes of *Streptococcus suis* infection in humans,” *Emerging Infectious Disease Journal*, vol. 20, no. 7, 2014.

[8] Y. J. Oh and S. H. Song, “A case of *Streptococcus suis* infection causing pneumonia with empyema in Korea,” *Tuberculosis and Respiratory Diseases*, vol. 73, no. 3, pp. 178–181, 2012.

[9] M. Gottschalk, J. Xu, C. Calzas, and M. Segura, “*Streptococcus suis*: a new emerging or an old neglected zoonotic pathogen?” *Future Microbiology*, vol. 5, no. 3, pp. 371–391, 2010.

[10] G. Goyette-Desjardins, J.-P. Auger, J. Xu, M. Segura, and M. Gottschalk, “*Streptococcus suis*, an important pig pathogen and emerging zoonotic agent—an update on the worldwide distribution based on serotyping and sequence typing,” *Emerging Microbes and Infections*, vol. 3, article e45, 2014.

[11] N. Fittipaldi, J. Xu, S. Lacouture et al., “Lineage and virulence of *Streptococcus suis* serotype 2 isolates from North America,” *Emerging Infectious Disease Journal*, vol. 17, no. 12, pp. 2239–2244, 2011, http://wwwnc.cdc.gov/eid/article/17/12/11-0609_article.

[12] H. D. T. Nghia, T. P. Tu Le, M. Wolbers et al., “Risk factors of *Streptococcus suis* infection in Vietnam. A case-control study,” *PLoS ONE*, vol. 6, Article ID e17604, 2011.

[13] N. Fittipaldi, M. Segura, D. Grenier, and M. Gottschalk, “Virulence factors involved in the pathogenesis of the infection caused by the swine pathogen and zoonotic agent *Streptococcus suis*,” *Future Microbiology*, vol. 7, no. 2, pp. 259–279, 2012.

[14] E. Ma, P. H. Chung, T. So et al., “*Streptococcus suis* infection in Hong Kong: an emerging infectious disease?” *Epidemiology and Infection*, vol. 136, no. 12, pp. 1691–1697, 2008.

[15] R. Leclercq, R. Cantón, D. F. J. Brown et al., “EUCAST expert rules in antimicrobial susceptibility testing,” http://www.eucast.org/fileadmin/src/media/PDFs/EUCAST_files/Expert_Rules/EUCAST-Expert-rules-v2-Clin_Microbiol_Infect_2013_19_141%E2%80%93160.pdf.

[16] M. S. Princivalli, C. Palmieri, and G. Magi, “Genetic diversity of *Streptococcus suis* clinical isolates from pigs and humans in Italy (2003–2007),” *Euro Surveillance*, vol. 14, no. 33, article 4, 2009.

[17] T. M. File Jr. and L. A. Mandell, “What is optimal antimicrobial therapy for bacteremic pneumococcal pneumonia?” *Clinical Infectious Diseases*, vol. 36, no. 4, pp. 396–398, 2003.

[18] H. Yu, H. Jing, Z. Chen et al., “Human *Streptococcus suis* outbreak, Sichuan, China,” *Emerging Infectious Diseases*, vol. 12, no. 6, pp. 914–920, 2006.

[19] N. Navacharoen, V. Chantharochavong, C. Hanpraserthong, J. Kangsanarak, and S. Lekagul, “Hearing and vestibular loss in *Streptococcus suis* infection from swine and traditional raw pork exposure in northern Thailand,” *Journal of Laryngology and Otology*, vol. 123, no. 8, pp. 857–862, 2009.