Streptococcus suis Meningitis: The Newest Serious Infectious Disease†

Siwarith Rusmeechan MD*,
Paoworamol Sribusara MD*

† *The large series report from Phitsanulok Thailand*
* *Department of Medicine, Buddhachinaraj Hospital, Phitsanuloke*

The authors report 41 patients with meningitis caused by Streptococcus suis. The clinical feature of the meningitis is characteristic with severe sensorineural hearing loss, developing early during the course of meningitis. These patients were cured with high doses of penicillin or third generation cephalosporins but the deafness remained permanent. The mechanism of the cochlear and vestibular damage is uncertain; presumably, it is caused by some oto-toxins from bacteria. The disease may become an occupational risk of pork handlers and a public health problem in Thailand.

Keywords: *Streptococcus suis, Meningitis, Permanent deafness*

J Med Assoc Thai 2008; 91 (5): 654-8
Full text. e-Journal: *http://www.medassocthai.org/journal*

Although antibiotics have been in use for more than 60 years, bacterial meningitis still remains a serious disease with high morbidity and mortality in many countries. The four most common causes of bacterial meningitis are *Hemophilus influenzae*, *Streptococcus pneumonia*[1], *Neisseria meningitidis*, and *Listeria monocytogenes*. Eighty five percent of all cases are caused by those four organisms; and only 10 percent caused by other organisms such as Gr. B streptococcus[2], *Staphylococcus aureus*, Aerobic Gram-negative bacilli, and others.

Streptococcus suis is a lancefield group R hemolytic streptococcus that causes epidemics of septicemia and meningoencephalitis in pigs and piglets[1,3]. This infection also occurs in human. *Streptococcus suis* infection has been increasingly recognized in European countries[4,5], Hong Kong[6] and recently in South East Asia. Although its clinical features and epidemiology are characteristics, the disease is still unfamiliar[7], underdiagnosed, and is not described in current textbooks of medicine[8] and infectious diseases[9]. In the present report the authors describe 41 patients with *Streptococcus suis* meningitis to draw attention to this disease in Thailand, which is a major pork-breeding country.

Correspondence to: Rusmeechan S, Department of Medicine, Buddhachinaraj Hospital, Phitsanulok, Thailand. Phone: 055-219-844, Fax: 055-258-812, E-mail: siwasith@hotmail.com

Material and Method

Forty-one cases were identified during the study period (2001-2006). The charts that included the data of incidence age, microbial data, clinical manifestations, laboratory finding in whom *Streptococcus suis* meningitis were diagnosed at Buddhachinaraj (regional) Hospital, Phitsanulok Thailand, were reviewed. Patients who were initially treated at other hospitals (in lower north region of Thailand) but were transferred to this hospital for further therapy were also included.

The diagnosis of meningitis caused by *Streptococcus suis* was based on compatible clinical pictures with bacterial meningitis and either a positive cerebrospinal fluid culture or a negative cerebrospinal fluid culture with finding of neutrophilic pleocytosis with either the identification of gram positive diplococci on gram's staining of cerebrospinal fluid or at least one specimen of positive blood culture. Patients with culture negative meningitis were included in the present study if they presented with a compatible clinical picture (ataxia, bilateral hearing loss,etc) of *Streptococcus suis* meningitis.

The following details were reviewed from the patient records, causative agent, underlying diseases, temperature, days with fever, neck stiffness, focal cerebral defects, papilledema, CSF opening pressure, examination of the CSF (complete blood counts and differential cell counts, gram staining, glucose, protein values), wbc, blood cultures, treatments, complications, and special investigations (CAT scan, audiogram etc.). All case were summarized as frequency and percentage.

Results

Of the 41 cases identified during the present study period 28 (68%) were male and 13 (32%) were female. The duration of the present study status was from 2001-2006. The age range was from 21 to more than 80 with four patients aged 21 to 40, 36 patients aged 40 to 80, and one patient was older than 80 years. Predisposing factors might have been alcoholism in eight patients(20%) or diabetes mellitus in five patients (12%). The other 28 patients (68%) did not have any predisposing factors.

Signs and symptoms

Thirty-nine patients (95%) presented with fever (T > 38.0C) and the classic triad of symptoms (fever, nuchal rigidity, and impaired consciousness. Only two patients had no fever on presentation. Furthermore, 90% of patients (37) had fever three days prior to admission, and 2% had fever > 3 days prior to admission.

Neck stiffness was present in 39 (95%) patients on initial physical examination and this incidence was not significantly different among the age groups. No rash or other skin lesions was seen in any of the patients.

Neurologic findings

Twenty-two patients (54%) had an abnormally mental status, of which 12 patients (30%) were drowsy, 10 patients (24%) were confused or lethargic, and no patient were stupourus or unresponsive to all stimuli. Nineteen patients (46%) were normally alert and none had a seizure of any type.

Although the results of fundoscopic examination were not recorded for many patients, blurred disk, early papilldema, or papilledma was recorded in three (7%) patients and all of them had very high CSF open pressure (30-60 mm of H_2O).

Cranial nerve palsy

Two patients (5%) had cranial nerve VI palsy finding on admission, associated with high CSF open pressure and high pleocytosis (4,000-9,000), which disappeared to normal after recovery periods.

One patient developed hemiparesis at admission that persisted until discharge.

Hearing loss

Thirty-eight patients (93%) had hearing loss at admission and the remaining three patients (7%) had detected hearing loss in the early periods (0-3 day) of admission. Only 17 (42%) patients had positive cerebellar signs. The most remarkable hearing loss was severe sensorineural deafness that developed early during the course of illness. The deafness was acute, bilateral, severe, and accompanied by tinnitus in the majority of cases.

Cerebrospinal fluid finding

Initial CSF values in patients with S. suis meningitis:

Variable	No. (%)
Opening pressure (mm H_2O)	
0-139	3 (7%)
140-299	10 (24%)
> 300	28 (68%)
WBC counts	
0-99	10 (24%)
100-4999	28 (68%)
5000-9999	3 (7%)
Percent neutrophiles	
0-19	2 (5%)
20-79	11 (27%)
> 80	28 (68%)
TOTAL protein level > 40 mg/dl	40 (97%)
Glucose level < 40 mg/dl	40 (97%)
Gram stain: positive	20 (48%)
Culture: positive	37 (90%)
Hemoculture: positive	35 (85%)

Lumbar puncture was performed in all patients, the opening CSF pressure greater than 300 mm H_2O was noted in nearly 70% of the patients. No difference in the level of consciousness was found between patients who had a high opening pressure compared with patients who had a normal one. All patients, except one, were found to have a decreased glucose level in the CSF and an increased protein level. White blood cell count greater than 0.100×10^9 / L except only 10 (24%) of the patients, more than 90% of cases shown the white blood cells in the CSF were polymorphonuclear leukocytes predominantly.

Bacteria were detected with gram stain of the CSF nearly 50% of the samples, but a culture of the CSF was positive in 37 (90%). Blood culture were positive in only 35 (85%).

Computerized tomographic scanning

A cranial computed tomographic scan were performed on six patients (15%) because of cranial nerve palsy in two (5%), papilledema in three (7%) and confusion in one patient. Five patients had abnormal scans, with cerebral edema and enhancement of sulci and gyri.

Treatment

During the early period of the present study, 22 (53%) patients received empiric treatment with penicillin with or without combination therapy with chloramphenicol. The use of these drugs changed a few years into the study to third generation cephalosporins. Most patients received penicillin as the main drug treatment after the microbial agents had been identified. The pattern of sensitivity of organisms to penicillin did not significantly change and the duration of treatment was generally 10 to 14 days.

Table 1. Clinical and laboratory characteristics on admission for 41 cases of *Streptococcus suis* meningitis from Phitsanuloke, Thailand (2000-2006)

Demographics	
Mean age, year	37
Men : women	28:13
Duration of symptoms < 72h	37 (90%)
Predisposingd disorders	13 (32%)
Symptoms & signs	
Body temperature > 38°C	39 (95%)
Headache	40 (97%)
Neck stiffness	39 (95%)
Consciousness	
< 14 (altered mental status)	22 (54%)
< 8 (coma)	-
Seizures	0
Papilloedema	3 (7%)
Cranial nerve palsies (CN 6)	2 (5%)
Hearing loss	38 (93%)
Ataxia	12 (29%)
Hemiparesis	1 (2%)
CSF Examination	
White cell count (per mm)	
< 100	11 (27%)
100-999	22 (53%)
1000-10000	8 (20%)
> 10000	-
CSF: blood glucose ratio (< 50%)	28 (68%)
Protein (g/L) (> 40 mg/dl)	25 (61%)
Positive gram stain	20 (48%)
Positive CSF culture	37 (90%)
Positive blood culture	35 (85%)

Complication

Hearing loss (NSHL) was found in all patients in the present study. All patients had a significantly permanent loss for a long period of follow up (> 1 year). Three cases had partially improvements of audiogram but hearing remained impaired. Ataxia were temporary impaired and disappeared in 3 to 6 weeks after the treatment period. Only four (10%) remained with mild ataxia for more than 6 weeks.

Mortality

There was no mortality in the present study and no difference outcome in any patients who had underlying disorder or not.

Discussion

The incidence of *Streptococcus suis* was only 1% of purulent meningitis in this report. The epidemiology of *Streptococcus suis* meningitis was quite different from other streptococcal meningitis[10]. This organism infects pigs and piglets, producing epidemics of meningoencephalitis, endocarditis, polyserositis, and pneumonitis. The majority of human infection occurs in pork handlers, particularly in slaughterhouse workers and by minor wounds or skin abrasions contaminated by raw pork or viscera of pigs. The early reports from European countries showed the infection in human, particularly in pork handlers[11,12]. In Asia early reports from Hong Kong shows that *Streptococcus suis* is a common cause of meningitis.

In Thailand, there are many small series of cases from many parts of the country[17-21] where pig breeding is common. Although it is not recognized often, doctors should pays attention to their different features and details.

The clinical features are septicemia, meningitis, hearing loss, ataxia, no septic arthritis, and endophthalmitis as prior reports stated. Furthermore, usually, the meningitis is acute[13]. The white cell counts in the CSF are variable and range from 0.009-5.1x10^9/L with neutrophiles from 10-100%. The glucose concentration in the CSF is low and protein is raised. The gram stain of the CSF sediment may reveal the organism, which may resemble pneumococci or enterococci.

Blood culture is often positive, as in the presented patients.

The most remarkable feature of *Streptococcus suis* meningitis is severe sensorineural deafness, which develops early during the course of the meningitis in the majority of patients. The deafness is acute, severe, bilateral, and may be accompanied by tinnitus, and the majority are usually permanent[14]. In some patients, damaged to the vestibular nerve also occurs[15]. Sensorineural hearing loss in *Streptococcus suis* meningitis is different from other pyogenic meningitis, which are much less common, rarely severe and usually transient. The other uncommon features are transient visual loss, nystagmus, and ocular palsy. The *Streptococcus suis* meningitis usually responds very well to treatment with large doses of intravenous penicillin. Rarely the organism is resistant to penicillin. Although, within 24 hours of treatment, the fever, headache and neck stiffness often resolve, and deafness is usually permanent.

This is a large report of 41 cases from the lower north part of Thailand. Although the present report shows classical signs and symptoms of *Streptococcus suis* meningitis as previous reports, this report also shows some important variations in clinical features and epidemiologic findings. The no-mortality case from this report is different from Republic of China, Hong Kong, and European countries. It is probably due to different serotypes or different specific toxins of bacteria. While workers handling fresh pork products in slaughterhouse need awareness, more evidences from recent reports[16] show that pig breeders, butchers and any persons who handle or eat uncooked pork products can be at high risk of infection by this organism. The data from the present report show that the majority of cases had no direct contact with pigs and piglets. This shows evidence of other modes of transmission such as respiratory tract, or gastrointestinal tract However, although these infections have more reports with typical characteristics that are easy to recognize, the authors agreed with other previous comments that *Streptococcus suis* meningitis in humans has been underdiagnosed because people and doctors are less awareness of this occupational disease. In conclusion, appropriate handling of fresh pork products can prevent the infection and early diagnosis with early treatment may prevent disabling deafness. The recent surveillance reports from many provinces in the Northern part of Thailand show more evidence that streptococcus suis meningitis may be a serious infectious disease that requires more awareness and care by all medical personel. This is is applicable in Thailand as well as around the world.

References

1. Windsor RS, Elliott SD. Streptococcal infection in young pigs. IV. An outbreak of streptococcal meningitis in weaned pigs. J Hyg (Lond) 1975; 75: 69-78.
2. Twort CH. Group R streptococcal meningitis (*Streptococcus suis* type II): a new industrial disease? Br Med J (Clin Res Ed) 1981; 282: 523-4.
3. Porcine streptococci causing meningitis and septicaemia in man Lancet 1975; 1: 1286-8.
4. Lutticken R, Temme N, Hahn G, Bartelheimer EW. Meningitis caused by *Streptococcus suis*: case report and review of the literature. Infection 1986; 14: 181-5.
5. Colaert J, Allewaert M, Magerman H, Vandeven J, Vandepitte J. Streptococcus suis meningitis in man. First reported observation in Belgium. Acta Clin Belg 1985; 40: 314-7.
6. Chau PY, Huang CY, Kay R. *Streptococcus suis* meningitis. An important underdiagnosed disease in Hong Kong. Med J Aust 1983; 1: 414-6, 417.
7. Facklam RR. Isolation and indentification of streptococci. Part III. Presumptive identification of streptococci by nonserological methods. Georgia: CDC; 1980.
8. Mandell GL, Doulas R, Bennett JE. Principles and practice of infectious disease. 2nd ed. New York: John Wiley and Sons; 1985.
9. Bisno AB. Streptococcal infections. In: Braunwald E, Fauci AS, Kasper DL, Hauser SL, Longo DL, Jameson JL, editors. Harrison's principles and practice of internal medicine. 11th ed. New York: Mc Graw-Hill; 1987: 543-50.
10. Lerner PI. Meningitis caused by Streptococcus in adults. J Infect Dis 1975; 131(Suppl): S9-16.
11. Clifton-Hadley FA, Alexander TJ, Enright MR, Guise J. Monitoring herds for *Streptococcus suis* type 2 by sampling tonsils of slaughter pigs. Vet Rec 1984; 115: 562-4.
12. Breton J, Mitchell WR, Rosendal S. *Streptococcus suis* in slaughter pigs and abattoir workers. Can J Vet Res 1986; 50: 338-41.
13. Agass MJ, Willoughby CP, Bron AJ, Mitchell CJ, Mayon-White RT. Meningitis and endophthalmitis caused by *Streptococcus suis* type II (group R). Br Med J 1977; 2: 167-8.
14. Shneerson JM, Chattopadhyay B, Murphy MF, Fawcett IW. Permanent perceptive deafness due

to *Streptococcus suis* type II infection. J Laryngol Otol 1980; 94: 425-7.
15. Deafness after meningitis. Lancet 1986; 1: 134-5.
16. Weekly Epidemiological Surveillance Report (WESR) 2007; 38: 393-8.
17. Leelarasamee A, Nilakul C, Tien-Grin S, Srifuengfung S, Susaengrat W. *Streptococcus suis* toxic-shock syndrome and meningitis. J Med Assoc Thai 1997; 80: 63-8.
18. Vilaichone RK, Vilaichone W, Nunthapisud P, Wilde H. *Streptococcus suis* infection in Thailand. J Med Assoc Thai 2002; 85(Suppl 1): S109-17.
19. Fongcom A, Pruksakorn S, Mongkol R, Tharavichitkul P, Yoonim N. *Streptococcus suis* infection in northem Thailand. J Med Assoc Thai 2001; 84: 1502-8.
20. Vilaichone RK, Mahachai V, Nunthapisud P. *Streptococcus suis* meningitis: report. J Med Assoc Thai 2000; 83: 1274-7.
21. Chotmongkol V, Janma J, Kawamatawong T. *Streptococcus suis* meningitis: report of a case. J Med Assoc Thai 1999; 82: 922-4.

Streptococcus suis: สาเหตุใหม่ของโรคเยื่อหุ้มสมองอักเสบ

ศิวฤทธิ์ รัศมีจันทร์, ปวรมน ศรีบุษรา

ได้รายงานผู้ป่วยเยื่อหุ้มสมองอักเสบจากเชื้อ Streptococcus suis จำนวน 41 รายเป็นรายงานที่ใหญ่ที่สุดเคยมีมา ลักษณะสำคัญของเยื่อหุ้มสมองอักเสบชนิดนี้คือ อาการหูหนวกสองข้าง และเดินเซอย่างเฉียบพลัน โรคนี้จากรายงานแรก ๆ กล่าวถึงสาเหตุของการติดเชื้อจากสุกร โดยเฉพาะในผู้ใกล้ชิดหรือสัมผัสเนื้อสุกรดิบ แต่รายงานนี้แสดงถึงการติดเชื้อมีหลายช่องทางกว่าที่รายงานไว้แต่เดิม คาดว่าโรคนี้จะเป็นปัญหาสำคัญอันหนึ่งทางสาธารณสุขในอนาคตอย่างแน่นอน