

Bacterial Meningitis Caused by *Streptococcus Suis*, Complicated by Secondary Ventriculoperitoneal Shunt-Associated Peritonitis: A Rare Clinical Case Presentation

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Abstract

The main method of treating hydrocephalus is through liquor shunt surgery, with preference given to Ventriculoperitoneal Shunts (VPS). However, as the number of implanted bypass systems in the abdominal cavity increases, so does the number of complications, both intraventricular and abdominal. We present a unique case of primary bacterial meningitis caused by *Streptococcus suis*, which was complicated by secondary shunt-associated diffuse fibrinous peritonitis in a 28-year-old female patient.

Introduction

Cerebrospinal Fluid (CSF) diversion is the main method of treating hydrocephalus [1], with an estimated 30,000 ventriculostomies performed annually in the United States. The incidence of Ventriculoperitoneal Shunt (VPS) failure during the first year after initial implantation has been reported to be as high as 11-25% [2,3]. VPS account for 97.7% of all implantations [4], but as the number of implanted bypass systems in the abdominal cavity increases, so does the number of complications, including intraventricular infections, bending or obstruction of the catheter, and abdominal complications such as intestinal obstruction and traumatic injuries to intra-abdominal organs [5-8]. Infectious complications typically occur within the first 6 months after VPS, with the majority occurring within the first 3 months after surgery. Late infectious complications are rare and have different mechanisms. The frequency of shunt infections, according to various sources, ranges from 0.17% to 30% [9]. Peritonitis associated with VPS, as

a complication of meningitis, is mainly seen in pediatric patients [10-12].

Case presentation

A 28-year-old woman was admitted to City Mariinsky Hospital with complaints of headache, pain in the left and lower abdomen, a body temperature of 38.5°C, severe weakness, and nausea. According to her medical history, she first experienced symptoms of the disease 9 days prior to her hospitalization at City Mariinsky Hospital. These symptoms included catarrhal symptoms, headache, a fever of 38.5°C, acute abdominal pain, nausea, and repeated vomiting. She attempted to treat herself at home with non-steroidal analgesics but did not experience significant relief. On the ninth day after experiencing first symptoms, she was urgently hospitalized at the Clinical Infectious Diseases Hospital named after S.P. Botkin with a suspected acute intestinal infection. However, after a comprehensive examination, this diagnosis was ruled out. An ultrasound of her abdominal organs revealed a

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significant amount of fluid in the abdominal cavity. As a result, she was transferred to City Mariinsky Hospital on the same day with a suspected surgical pathology, specifically an “acute abdomen”. It is also important to note that the patient has a history of perinatal damage to her central nervous system in the form of intraventricular hemorrhage during childbirth. This condition was further complicated by the development of occlusive hydrocephalus. The patient has undergone ventriculoperitoneal shunting procedures in 1995, 1997, 2003, and 2006. She currently works as a nurse and denies any bad habits. Additionally, she denies any contact with infectious patients.

Upon admission to the hospital, the patient’s condition was serious. The neurological status was marked by drowsiness and lethargy, with the patient answering questions correctly but only in monosyllables. The patient’s body position was passive, lying down. The skin appeared clean and of normal color, temperature, and humidity, with no rashes, hemorrhages, or peeling. The patient’s axillary temperature was 38.3°C. Upon auscultation of the lungs, vesicular breathing was heard with no wheezes, and the respiratory rate was 22 breaths per minute. The patient’s heart sounds were rhythmic and muffled, with a heart rate of 88 beats per minute and a blood pressure of 133/74 mmHg. The abdomen was tender upon palpation in the left lower quadrant, with positive peritoneal symptoms. Rigidity of the neck muscles was noted at the level of three transverse fingers.

Laboratory data showed the following: A complete blood count on the day of hospitalization revealed a red blood cell count of $3.69 \times 10^9/l$, hemoglobin level of 97 g/l, platelet count of $538 \times 10^9/l$, leukocyte count of $26.5 \times 10^9/l$, and the following differential: segmented neutrophils 80%, band neutrophils 16%, monocytes 2%, and lymphocytes 2%. A biochemical blood test on the day of hospitalization showed the following results: ALT 81 U/l, AST 72 U/l, total protein 66 g/l, albumin 31 U/l, amylase 40 g/l, glucose 5.63 mmol/l, and C-reactive protein 272.7 mg/l.

Data from instrumental research methods included an ultrasound of the abdominal cavity, which showed signs of bilateral calico ectasia and fluid in the pelvis with a volume of up to 300 ml. A CT scan of the brain revealed a ventricular catheter in the projection of the posterior horn of the right lateral ventricle (Figure 1A). A CT scan of the abdominal organs showed interloop fluid in the lower floors of the abdominal cavity, in the projection of the installed IPS, spreading into the pelvic cavity, with a layer thickness of up to 4.5 cm, compressing the intestinal loops (Figure 1B,C).

The patient was examined by a general surgeon and, with suspected peritonitis, was urgently taken to the operating room, where diagnostic laparoscopy was performed. Turbid white fluid was detected in the abdominal cavity and the peritoneal end of the VPS was visualized. Access conversion was then performed, followed by laparotomy, externalization of the shunt, and drainage of the abdominal cavity. Samples of cerebrospinal fluid from the shunt system and the contents of the abdominal cavity were sent for laboratory and bacteriological examination.

The results of the analysis of the cerebrospinal fluid obtained from the shunt system showed a protein level of 1.1 g/l and glucose level of 3.16 g/l. Cell count was found to be $11008 \times 10^6/l$, with 92% neutrophils and 8% lymphocytes. A microbiological

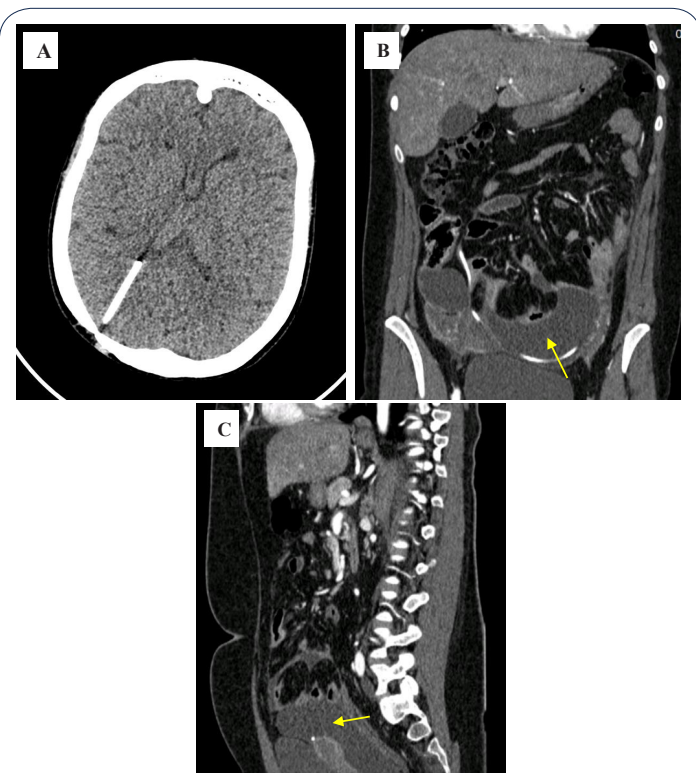


Figure 1: Results of Multi-Slice Spiral Computed Tomography (MSCT) performed upon admission to the hospital.

A: MSCT of the head. A ventricular catheter is installed in the projection of the posterior horn of the right lateral ventricle. The lateral ventricles are narrow.

B,C: MSCT of the abdomen. Free fluid (CSF) in the projection of the installed peritoneal end of the VPS, spreading into the pelvic cavity (indicated by the arrow), the thickness of the layer is up to 4.5 cm.

(bacteriological) study of the cerebrospinal fluid revealed the growth of *Streptococcus suis*. Similarly, a bacteriological study of the exudate from the abdominal cavity also showed the growth of *Streptococcus suis*. An antibiogram revealed the sensitivity of the microorganism to a wide range of antibiotics, including Benzylpenicillin, Vancomycin, Clindamycin, Cefotaxime, Erythromycin, and Levofloxacin.

Based on clinical, laboratory, instrumental, and intraoperative data, the patient was diagnosed with primary bacterial meningitis caused by *Streptococcus suis*, classified as moderate to severe and complicated by secondary shunt-associated diffuse fibrinous peritonitis. In the postoperative period, the patient received treatment in the neurosurgical department, including antibacterial therapy with Ceftriaxone (4 g per day), Vancomycin (2 g per day), Ciprofloxacin (1 g per day), and symptomatic therapy. The patient’s condition showed positive progress, with a regression of infectious-inflammatory and pain symptoms and an improvement in overall well-being.

Laboratory parameters were closely monitored, and additional cerebrospinal fluid samples were taken from the distal end of the functioning peritoneal shunt for laboratory and bacteriological examination.

On the 27th day of illness, the patient’s complete blood count showed the following results: Red blood cells $3.62 \times 10^9/l$, hemoglobin 97 g/l, platelets $538 \times 10^9/l$, leukocytes $3.62 \times 10^9/l$, seg-

mented neutrophils 72%, band neutrophils 5%, monocytes 4%, and lymphocytes 13%. A biochemical blood test on the same day revealed the following values: ALT 25 U/l, AST 31 U/l, total protein 81 g/l, albumin 44 U/l, amylase 90 g/l, glucose 4.8 mmol/l, and C-reactive protein 23.9 mg/l. The results of cerebrospinal fluid analysis on the 27th day of illness showed a protein level of 0.33 g/l, glucose level of 3.74 g/l, and cell count of 1×10^6 /l, with 32% neutrophils and 68% lymphocytes. A bacteriological study did not reveal the growth of any aerobic or anaerobic microorganisms. During the follow-up MSCT, normalization of the ventricular size was observed (Figure 2), with no signs of increasing hydrocephalus.

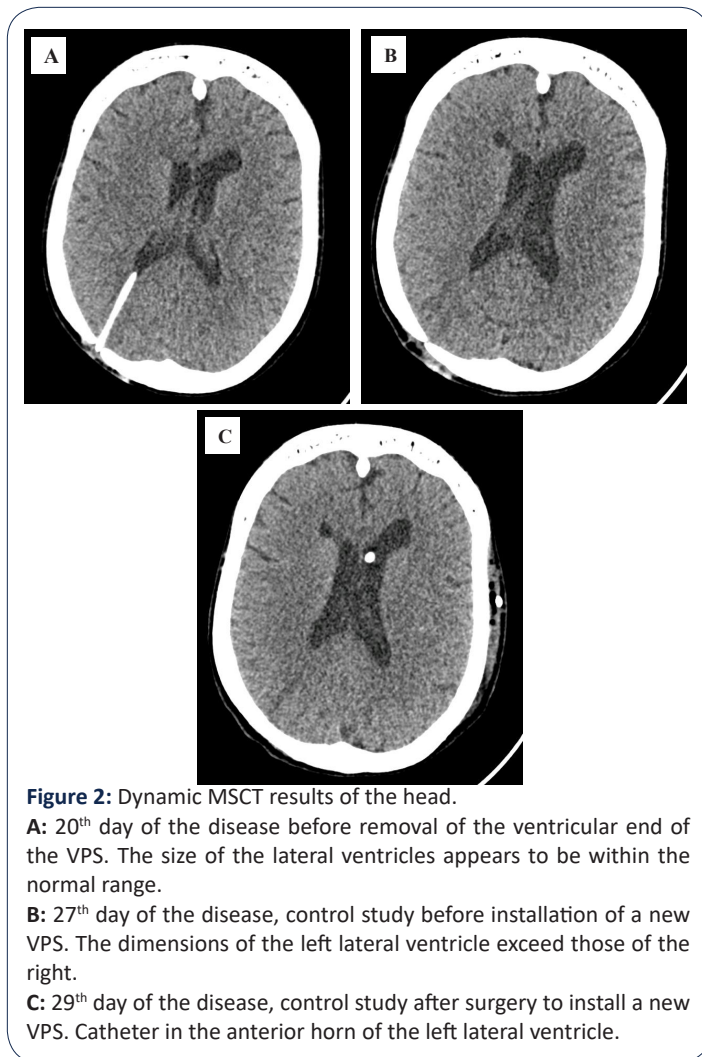


Figure 2: Dynamic MSCT results of the head.
A: 20th day of the disease before removal of the ventricular end of the VPS. The size of the lateral ventricles appears to be within the normal range.
B: 27th day of the disease, control study before installation of a new VPS. The dimensions of the left lateral ventricle exceed those of the right.
C: 29th day of the disease, control study after surgery to install a new VPS. Catheter in the anterior horn of the left lateral ventricle.

On the 28th day after the onset of the disease, an operation was performed to remove the externalized ventriculoperitoneal shunt and install a new one. This was done after the infectious-inflammatory syndrome had completely regressed and laboratory parameters had normalized. The new shunt was placed from the left Kocher point to the left flank region of the abdominal cavity. The postoperative period went smoothly without any complications. The wounds healed well, and the sutures were removed on the 10th day. The patient was discharged in satisfactory condition on the 37th day for outpatient treatment.

Discussion

Streptococcus suis (*S. suis*) is a Gram-positive facultative anaerobe and a major pathogen of pigs that can be transmitted to hu-

mans [13]. Meningitis is the most common disease caused by this microorganism in humans, with the greatest danger being the development of sepsis and a high risk of death. Other clinical manifestations include enteritis, endocarditis, arthritis, endophthalmitis, uveitis, and spondylodiscitis [14-16]. Permanent hearing loss or vestibular dysfunction are the most common consequences of *S. suis* infection, especially in patients with meningitis. However, the most dangerous complication is the development of sepsis with a high risk of death [14]. Since the first reported case of human infection with *S. suis* in Denmark in 1968, more than 700 cases have been reported worldwide [17]. The majority of reported cases of human infection with *S. suis* occur in Southeast Asian countries, which are characterized by high population densities, large numbers of pig farms, and a national cuisine that involves eating raw or lightly cooked pork [16]. According to the literature, *S. suis* is susceptible to penicillin antibiotics, Ceftriaxone, and Vancomycin [18]. In our case, the patient was treated with Ceftriaxone, Ciprofloxacin, and Vancomycin.

Conclusion

The development of VPS-associated peritonitis as a serious complication of meningitis highlights the need for improved anti-epidemic measures for those working with pigs or consuming pork products. The incidence of diseases caused by *S. suis*, a new pathogen for humans, is increasing.

Declarations

Institutional review board statement: The work was carried out according to the principles of voluntariness and confidentiality in accordance with Federal Law "On the Basics of Health Protection of Citizens in Russian Federation" 21.11.2011 N 323-FZ, and the Helsinki Declaration on Human Rights.

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Conflicts of interest: The authors declare no conflicts of interest.

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