Ventriculoperitoneal shunt infection with *Mycobacterium fortuitum*: a rare offending organism

Case report

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Postoperative infection is one of the greatest potential morbidities of ventriculoperitoneal shunt surgery. The majority of infections can be linked to contamination with skin flora at the time of surgery, a phenomenon that has been well described. However, there is a paucity of literature regarding infection with nontuberculous mycobacteria. The authors report a case of postoperative ventriculoperitoneal shunt infection with *Mycobacterium fortuitum* and review the available neurosurgical literature and treatment strategies.

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**Key Words**  
ventriculoperitoneal shunt  
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*Mycobacterium fortuitum*  
nontuberculous mycobacteria

**Abbreviations used in this paper:** EVD = external ventricular drain; MIC = minimum inhibitory concentration; NTM = nontuberculous mycobacteria; RGM = rapidly growing mycobacteria; TMP-SMZ = trimethoprim-sulfamethoxazole; VP = ventriculoperitoneal; WBC = white blood cell.
Nontuberculous mycobacterial shunt infection

Hospital Course and Follow-Up. Empiric therapy with intravenous vancomycin was initiated, and the patient was taken to the operating room the following day for shunt removal and placement of an external ventricular drain (EVD). He had a low-grade fever of up to 38°C on his first postoperative night, but otherwise appeared nontoxic. Gram staining from an intraoperative wound swab revealed rare gram-negative rods. Gram staining of specimens obtained from the distal catheter and CSF revealed gram-positive rods. CSF studies showed glucose 67 mg/dl, protein 14 mg/dl, and absence of white cells. Antibiotic coverage was broadened postoperatively to vancomycin and ceftriaxone.

The patient remained febrile, with a maximum temperature of 38.6°C, on postoperative Day 1 despite dual antimicrobial therapy. An abdominal ultrasound examination obtained the following day revealed an intraperitoneal pseudocyst. Although distal catheter cultures were suspicious for acid-fast bacilli within 3 days following shunt removal, his antibiotic regimen was reduced to vancomycin monotherapy for presumed coagulase-negative *Staphylococcus* shunt infection. The acid-fast bacilli found on culture were presumed to be due to contamination.

On Day 4 the patient began to manifest sharp increases in his fever, with a temperature as high as 39.7°C, and experienced concomitant headache, abdominal pain, and emesis. His CSF values gradually worsened, showing a rising protein level and WBC count and a falling glucose level. The EVD, although impregnated with clindamycin and rifampin, was found to be colonized with acid-fast bacteria and was replaced. During the same time period the results of all cultures from the initial surgery became available and were reported as positive for acid-fast bacilli. The abdominal pseudocyst was drained percutaneously and Gram stain results were strongly positive for acid-fast bacilli. Antimicrobial therapy was broadened on postoperative Day 6 to meropenem, moxifloxacin, linezolid, and amikacin to cover RGM in addition to coagulase-negative *Staphylococcus*. Specimens were sent to the National Jewish Health Mycobacteriology Laboratory in Denver, Colorado, and to the California Department of Public Health Laboratory for confirmatory and susceptibility testing.

The remainder of the patient’s hospital course was uncomplicated. After his fever subsided and the abdominal fluid collection resolved, his shunt was reinserted and a Broviac catheter was placed for long-term parenteral therapy. Susceptibility and CSF penetration data were used to guide therapy, and he was discharged on a regimen of intravenous meropenem, oral trimethoprim-sulfamethoxazole (TMP-SMZ), and oral moxifloxacin. The final results of cultures identified the infecting organism as *M. fortuitum*. After 3 months of treatment, intravenous meropenem was discontinued. Dual therapy with oral TMP-SMZ and moxifloxacin was continued. In total, the patient received 9 months of antimicrobial therapy. Although antimicrobial therapy was planned for a total duration of 1 year, the patient was symptom free at 9 months and had difficulty maintaining compliance. His antimicrobial treatment was therefore stopped. He has remained clinically stable without recurrent signs or symptoms of infection for 2 years since his shunt was removed.

Discussion

Epidemiology

Nontuberculous mycobacteria (NTM) are ubiquitous environmental organisms. They have been isolated in 55% of water supplies to dialysis centers and 30%–78% of soil specimens and are commonly found in tap water. Different NTM species have the propensity to cause infection in specific clinical settings. In immunocompetent hosts, infection is usually due to posttraumatic wound contamination, surgical site contamination, or catheter-related sepsis. Disseminated infection occurs more often in the immunocompromised host, but has been observed in presumed immunocompetent patients.

CNS Infection With Rapidly Growing Mycobacteria

The most comprehensive review of CNS disease caused by rapidly growing mycobacteria includes 19 reported cases since 1970, not including single cases of intrathecal baclofen pump infection, a *Mycobacterium goodii* shunt infection, or our case. Of the 19 primary and secondary CNS infections reviewed, 14 were caused by *M. fortuitum*. The most common clinical presentation was subacute meningitis, with symptom duration ranging from 3 days to 5 months. Two patients infected with *M. fortuitum* died; one had endocarditis and the other had disseminated disease in a setting of immunosuppression. *M. fortuitum* has the propensity to colonize foreign bodies such as central venous catheters, prostheses, heart valves, and shunts. Although these organisms may be among the normal respiratory and gastric flora of immunocompetent hosts, growth of these organisms from a normally sterile body site is highly suggestive of infection, as in our patient. There are currently 6 reported cases of VP or ventriculoatrial shunt and intrathecal pump infection with RGM in the literature. Interestingly, the isolated organism was *M. fortuitum* in 5 of the 6 cases.

NTM Neurosurgical Device Infection in the Literature

Uche et al. reported the only case of *M. goodii* VP shunt infection; their patient was a 60-year-old woman who had undergone shunt placement for treatment of post-aneurysmal hydrocephalus. She presented with wound breakdown, low-grade fever, and a normal peripheral WBC count. CSF from the externalized shunt revealed 29 WBC with a neutrophil predominance, protein 21 mg/dl, glucose 75 mg/dl, and many gram-positive rods. She was treated with intravenously administered vancomycin, but continued to manifest intermittent fever with persistently positive CSF gram stains. Within 3 days of the shunt externalization, cultures were positive for acid-fast bacilli, later identified as *M. goodii*. The shunt was removed in its entirety, and her fever resolved. She was placed on a 4- to 6-month course of oral moxifloxacin after completing a 5-week course of intravenous imipenem.

In Chan and colleagues’ report of a ventriculoatrial shunt infection with *M. fortuitum*, a 60-year-old woman presented nearly 1 month after shunt implantation with intermittent low-grade fevers, peripheral lymphocytosis, and elevated inflammatory markers. CSF studies were notable only for a mildly elevated protein level. When the pa-
tient’s fever persisted, a second CSF sample was obtained, which revealed acid-fast-positive organisms and grew *M. fortuitum* in less than 7 days. Despite removal of the colonized shunt, her condition deteriorated due to gross CSF contamination. Adequate treatment required a 10-week course of intravenous and intrathecal amikacin to achieve adequate CSF concentration of the antibiotic.

In 1999, Midani and Rathore reported a case of *M. fortuitum* VP shunt infection in a 13-year-old girl with spina bifida 1 month following open drainage of a retroperitoneal abscess.2 Despite being treated with an appropriate antimicrobial regimen for the organism isolated from her retroperitoneal abscess, the patient’s fevers persisted, and she developed tenderness along her shunt 2 weeks after completion of the antibiotic regimen. CSF studies performed at that time showed an elevated WBC count. Cultures were negative. The patient continued to manifest fevers, and her shunt was externalized 3 days later. At that time, CSF studies showed a rising WBC count, but the results of cultures remained negative. Her mental status declined and her fevers persisted, prompting removal of her shunt hardware. Cultures from the shunt tubing grew acid-fast bacilli after 72 hours of incubation, later confirmed to be *M. fortuitum*. The patient was successfully treated with a 6-week course of intravenous amikacin and oral TMP-SMZ, followed by oral TMP-SMZ for an additional 6 months. A similar case of VP shunt infection in an adult was reported by Viswanathan et al. in 2004.13

Two cases have been reported in which implanted pumps were infected with *M. fortuitum*. In 2008, Alibadi and Osenbach reported on an immunocompetent 60-year-old man with a traumatic spinal cord injury and consequent spastic quadriaparesis, who presented with an indolent low-grade surgical site infection 6 weeks after baclofen pump implantation.1 Cultures at the time grew coagulase-negative *Staphylococcus* and *M. fortuitum*. The pump was explanted and the presence of NTM was presumed to be due to contamination. Four months later, at the time of pump reimplantation, the patient manifested signs of meningitis, including malaise, headaches, and low-grade fever. The pump was again explanted and CSF studies were obtained and showed a polymorphonuclear-predominant pleocytosis with elevated protein and low glucose levels. Cultures from the catheter tip and pump aspirate were strongly positive for *M. fortuitum*, and the infection was successfully treated with 3 months of intravenous amikacin, ciprofloxacin, and clarithromycin, followed by an additional 9 months of oral TMP-SMZ, ciprofloxacin, and clarithromycin. The second case, which was reported by Madaras-Kelly et al., involved a 45-year-old woman who presented with chronic fever, nausea, headache, and back pain 5 months after implantation of an intrathecal hydromorphone (Dilaudid) pump for failed back surgery syndrome.6 When her condition did not respond to treatment for a urinary tract infection, a CSF sample was obtained. Gram stain results revealed gram-positive bacilli that were also weakly acid-fast positive. The acid-fast stain was thought to represent a contaminant. She was started on broad-spectrum antibiotic therapy for presumptive bacterial meningitis. She continued to manifest headaches and diplopia after 2 weeks of treatment, despite no growth of any organism (including acid-fast bacilli) on CSF cultures. Shortly thereafter, the first culture demonstrated growth of an acid-fast organism. Empiric therapy was initiated with ciprofloxacin, isoniazid, and rifampin, but the patient’s condition did not improve over the next several days. Her regimen was changed to clarithromycin and imipenem. On Day 25 the pump was removed and her symptoms markedly improved. Cultures later demonstrated growth of *M. fortuitum*. The patient was discharged 1 month after admission on an 8-week regimen of intravenous imipenem, ciprofloxacin, doxycycline, and oral clarithromycin, followed by a 10-month course of oral antibiotics.

Management of *M. Fortuitum* Shunt Infection

Our patient, a 14-year-old boy with shunt-treated hydrocephalus, presented with *M. fortuitum* shunt infection in a manner similar to that reported in the literature. His clinical course was indolent and subacute, typical for a low-grade postoperative shunt infection with an organism of low virulence. Our suspicion for a complicated shunt infection was low, based on clinical presentation, unimpressive results of admission laboratory study values, and initial CSF studies suggestive of gram-positive bacilli, which were thought to represent *Propionibacterium acnes*. Since staphylococcal species are the most common cause of shunt infection and *P. acnes* are typically susceptible to vancomycin, monotherapy with vancomycin was employed until culture results could be finalized. When additional samples suggested coinfection with a gram-negative bacillus, therapy was broadened to include ceftriaxone.2 Eventually, when our patient failed to respond to broad-spectrum antibiotics and additional cultures of shunt hardware, CSF, and the EVD all showed acid-fast bacilli, an atypical mycobacterial etiology was considered.

Rapidly growing mycobacteria are known to form biofilms, a property of importance in the treatment algorithm for patients with implanted hardware. In every report, definitive treatment required explantation of all hardware, which in each case was colonized. Illustrating the low virulence of the organism, Chan et al.3 were able, despite gross CSF contamination and florid meningitis, to achieve a good neurological recovery with combined intrathecal and intravenous antibiotic therapy. This is in stark contrast to outcomes seen with typical tuberculous meningitis. Although CSF cultures were positive for *M. fortuitum* in the case reported by Madaras-Kelly et al.6 and in our case, neither of these 2 patients required intrathecal treatment. Eradication was achieved with hardware explantation and combination antimicrobial treatment.

Due to the rarity of infection with these organisms, there are no published guidelines for timing of shunt re-implantation. In our case, timing of shunt replacement was guided by the absence of clinical signs of infection, several days of negative CSF cultures with a normal CSF profile, a normalized temperature curve, and a normal peripheral WBC count. A contralateral shunt was placed to minimize the chance for contamination.

Susceptibility testing is exceedingly important for successful treatment of NTM, as first-line antituberculous drugs typically do not have activity against these organ-

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isms and sensitivities differ among species. A strain of *M. fortuitum* was identified that was highly sensitive to all antimicrobial agents tested except for cefoxitin, to which it showed an intermediate level of susceptibility (minimum inhibitory concentration [MIC] 32 mcg/ml). The final drug combination used consisted of antibiotics that would not otherwise have been routinely chosen for a typical postoperative shunt infection with gram-positive bacilli. Effective antimicrobials were also selected for their propensity to cross the blood-brain barrier. Talati et al. recommend a duration of treatment for no less than 1 year, although a longer course of therapy should be considered for patients who are immunocompromised or those who are infected with *M. abscessus*, given that this organism is often more difficult to eradicate. Antibiotics should be chosen to achieve CSF concentrations that reach the MIC<sub>90</sub> for these organisms. Based on the MIC<sub>90</sub> of *M. fortuitum* and achievable CSF concentrations reported by Madaras-Kelly et al., we chose a triple-drug combination that included intravenously administered meropenem, orally administered moxifloxacin, and orally administered TMP-SMZ. After 3 months of good clinical response to this triple-drug regimen, meropenem was discontinued. Oral treatment with moxifloxacin and TMP-SMZ was continued for a total of 9 months, although the original plan had been to continue for a full year. The patient was last seen 2 years after shunt removal and was found to be clinically stable.

**Conclusions**

Atypical mycobacteria, although rarely causative organisms in ventricular shunt infections, should be considered as part of the differential diagnosis in postoperative VP shunt infection. They are ubiquitous organisms implicated in catheter-related and surgical site infections and are capable of forming biofilms. Signs of persistent wound infection, unremitting low-grade fevers, headaches, or vague signs of meningeal irritation should alert the clinician to the possibility of an untreated organism. Acid-fast stains, although not completely reliable, can aid in the diagnosis. Furthermore, isolation of these organisms from a normally sterile environment should raise particular suspicion. Fortunately, infection can be effectively treated with hardware removal and appropriate combination antimicrobial therapy based on MIC values. A course of multidrug therapy is usually required for a prolonged period of time, and good neurological outcomes can generally be achieved by adhering to these principles.

**Disclosure**

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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