

# Nontuberculous Mycobacterial Infection in Patients with Neurosurgical Hardware: Two Cases and A Review of the Literature

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## Abstract

Central nervous system infections with nontuberculous mycobacteria (NTM) are rare but have been increasing in frequency. A small fraction of these infections are related to surgical hardware, with approximately 20 cases reported. Patients typically present with an indolent course but can rapidly deteriorate. We report two novel cases of NTM infection in ventriculoperitoneal shunts, and review the literature on treatment options, challenges and outcomes in these patients. Clinicians should consider NTM when dealing with unusual hardware infections as it is an emerging infectious disease with high potential for morbidity and mortality.

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**Categories:** Infectious Disease, Neurosurgery

**Keywords:** nontuberculous mycobacteria, CNS infection, ventriculoperitoneal shunt, review, case report

## Introduction

Nontuberculous mycobacteria (NTM) defined as mycobacterial species other than *Mycobacterium tuberculosis* complex or *Mycobacterium leprae*. These organisms are ubiquitous and are found in water, dust and soil. Reports of infection with the organisms have been increasing worldwide, involving the lungs, skin, soft tissue and central nervous system [1]. Central nervous system (CNS) infections with NTM are rare but have high mortality.

Cerebral spinal fluid (CSF) infection from neurosurgical hardware is relatively common with rates ranging from 5% to 15% [2]. Most infections develop from colonization of skin flora [2]. We report two cases of NTM infection in neurosurgical patients related to ventriculoperitoneal (VP) shunt hardware, and review the literature, common presentations and current treatment strategies for CNS NTM infections related to neurosurgical hardware.

## Case Presentation

### Patient no. 1

A 24-year-old man with a history of posterior fossa tumor requiring VP shunting presented with worsening headaches, confusion and weight loss over several months. He had a history of vague pain along the shunt site, chest and abdomen as well as swallowing difficulties over several weeks. The patient had a history of multiple shunt revisions, the most recent of which approximately 10 months prior to our evaluation when he had undergone a proximal shunt revision for an obstructed ventricular catheter.

#### *Patient Course*

A CT of the head and abdomen revealed ventricles stable in size and a pseudocyst around his distal catheter (Figure 1).



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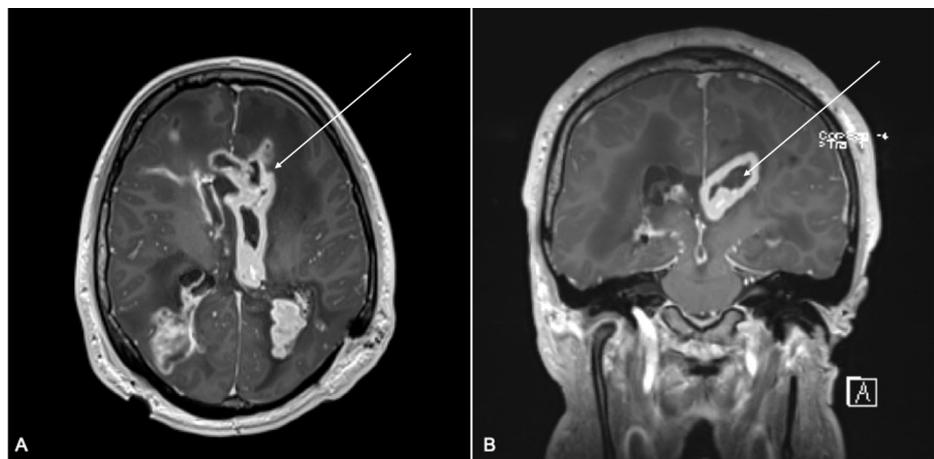
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**FIGURE 1: CT without contrast of head and abdomen**

CT head without contrast (A) showing stable ventricular size on admission. CT abdomen without contrast showing abdominal pseudocyst (arrow) on axial (B) and coronal (C) sequences.

He was immediately taken to the operating room for complete shunt externalization and placement of an external ventricular drain (EVD). He was started on broad-spectrum antibiotics (vancomycin, cefepime and metronidazole) and underwent percutaneous drainage of the pseudocyst in his abdomen. Cultures from both the percutaneous drainage and CSF were positive for acid-fast bacilli (AFB) and presumed NTM. His antibiotics were switched to azithromycin, amikacin and ceftiofloxacin by postadmission day 4. He continued to decompensate requiring multiple EVD replacements due to loculated ventriculitis. AFB was identified as *Mycobacterium abscessus*. Intrathecal (IT) amikacin was started on postadmission day 9. This was delayed due to the inability to clamp the EVD and safely administer IT amikacin. During the course of treatment, he had significant QTc interval prolongation which necessitated holding IV azithromycin and starting linezolid with readministration of azithromycin via nasogastric tube to minimize the risk of QTc prolongation by avoiding high peaks. He remained critically ill on a ventilator and required 12 EVD replacements in attempts to clear his loculated hydrocephalus. A brain MRI with contrast showed severe ventriculitis and cerebral inflammation (Figure 2).

**FIGURE 2: MRI T1 with contrast**

MRI T1 with contrast showing severe ventriculitis (arrow) and adjacent cerebral inflammatory changes with edema in axial (A) and coronal (B) sequences.

On postadmission day 30, he was transitioned to comfort care. He passed away on postadmission day 36.

**Patient no. 2**

A 71-year-old woman with normal pressure hydrocephalus status post placement of VP shunt approximately two years prior presented with recurrent and prolonged abdominal discomfort. She had a history of multiple abdominal surgeries including gastric lap band complicated by gastric perforation as well as cholecystectomy a year after her shunt was initially placed.

*Patient Course*

She was initially admitted with cellulitis and an abscess around an epigastric port site which crossed the VP shunt catheter. She underwent irrigation and drainage of the abscess as well as externalization of the VP shunt at her clavicle. Her hardware was removed completely, and she underwent an endoscopic third ventriculostomy. Abdominal wound catheter site culture grew *Mycobacterium fortuitum*. CSF remained negative on serial testing. She was treated with imipenem and doxycycline for five weeks, and then switched to oral azithromycin and doxycycline which was continued for three months. Doxycycline was changed to oral sulfamethoxazole-trimethoprim with azithromycin for another 1.5 months. She discontinued antibiotics at approximately six months due to nausea and intolerance. She continued to do well without any sign of infection.

**Discussion**

NTM is a rare cause of infection in patients with neurosurgical hardware. We present two cases of serious hardware infection with NTM. These types of infections are rare, with only 19 cases reported (Table 1) [3-18]. Most cases involved infections with subgroups within the *Mycobacterium fortuitum* (48% of cases) and *Mycobacterium abscessus* (43% of cases). None of the patients were immunocompromised. The age range was 2 to 71 years, with a median age of 45 years. The majority of neurosurgical hardware involved was shunt catheters (70% of cases). Interestingly, 43% (9/21) of patients in the series and 64% (9/14) of patients with shunt hardware had symptoms of distal infection with peritonitis, pseudocyst or abscess formation. The majority of patients (86%; 18/21) had a positive CSF culture. The majority of device-related NTM infections are caused by *Mycobacterium abscessus* and *Mycobacterium fortuitum*, such as in our patients, whereas disseminated disease most commonly caused by *Mycobacterium avium* complex. Even with rapid hardware explantation and high-dose antibiotic therapy, mortality was 19% (4/21).

Author/year	Age/sex	Organism	Hardware	+ CSF	Treatment	Prognosis
Current study	25M	<i>Mycobacterium abscessus</i>	VP shunt, pseudocyst	Yes	Azithromycin, amikacin, ceftazidime, IT amikacin	Death, 1 month
	71F	<i>Mycobacterium fortuitum</i>	VP shunt, pseudocyst	No	Imipenem, doxycycline (5 weeks), azithromycin, bactrim	Stable, 8 months f/u
Zakrzewski et al., 2019 [3]	26F	<i>Mycobacterium fortuitum</i>	LP shunt	Yes	Amikacin, imipenem, moxifloxacin, TMP/SMX	Stable, 1 year f/u
Xess et al., 2019 [4]	14F	<i>Mycobacterium fortuitum</i>	VP shunt, pseudocyst	Yes	Linezolid, ofloxacin, clofazimine, clarithromycin	Stable, 3 months
Giovanneze et al., 2018 [5]	46M	<i>Mycobacterium abscessus</i>	PEEK implant	No	Amikacin, imipenem, linezolid (6 weeks)	Stable 12 months f/u
Moritz et al., 2017 [6]	62M	<i>Mycobacterium goodii</i>	DBS electrode	No	TMP/SMX, doxycycline (6 months)	Stable, 12 months f/u
Baidya et al., 2016 [7]	59M	<i>Mycobacterium abscessus</i>	VP shunt	Yes	Amikacin, clarithromycin, meropenem	Death, 1 month
Levy et al., 2016 [8]	67F	<i>Mycobacterium abscessus</i>	VP shunt, distal tubing in abdomen	Yes	Meropenem, amikacin, azithromycin	Death, 1 month
Montero et al., 2015 [9]	30M	<i>Mycobacterium abscessus</i>	VP shunt, signs of peritonitis	Yes	Amikacin, imipenem, azithromycin, IT amikacin	Stable, 4 years f/u
Cadena et al., 2014 [10]	14M	<i>Mycobacterium fortuitum</i>	VP shunt, abd pseudocyst	Yes	Meropenem, TMP-SMX, moxifloxacin (9 months)	Stable, 2 years f/u
Lee et al., 2012 [11]	49M	<i>Mycobacterium abscessus</i>	Ommaya	Yes	Amikacin, clarithromycin, imipenem, minocycline, minofloxacin	Stable, 1 year f/u
	19F	<i>Mycobacterium abscessus</i>	EVD	Yes	Amikacin, clarithromycin, imipenem, levofloxacin, moxifloxacin	Stable, 1 year f/u
	28F	<i>Mycobacterium abscessus</i>	Ommaya	Yes	Amikacin, ceftazidime, clarithromycin, linezolid, meropenem, moxifloxacin, tigecycline, TMP/SMX	Stable, 2 years f/u
Aliabadi et al., 2008 [12]	60M	<i>Mycobacterium fortuitum</i>	Baclofen pump	Yes	Amikacin, ciprofloxacin, clarithromycin, TMP/SMX (19 months)	
Uche et al., 2008 [13]	60F	<i>Mycobacterium goodii</i>	VP shunt	Yes	Imipenem, moxifloxacin	Stable, 3 months
Viswanathan et al., 2004 [14]	60F	<i>Mycobacterium fortuitum</i>	VP shunt, abdominal abscess	Yes	Kanamycin, ciprofloxacin	Stable, 6 months
Quinn et al., 2002 [15]	12M	<i>Mycobacterium fortuitum</i>	VP shunt, peritonitis	Yes	Amikacin, ceftazidime, clarithromycin, TMP/SMX	Stable, 14 months

Midani et al., 1999 [16]	13F	Mycobacterium fortuitum	VP shunt, retroperitoneal abscess	Yes	Amikacin, TMP-SMX (6 months)	
Madaras-Kelly et al., 1999 [17]	45F	Mycobacterium fortuitum	IT pain pump	Yes	IV imipenem, ciprofloxacin, doxycycline, clarithromycin, 10 months of oral abx	Stable, 10 months
Flor et al., 1996 [18]	2M	Mycobacterium gordonae	VP shunt, peritonitis	Yes	Isoniazid, ethambutol, streptomycin	Stable, unknown f/u
Chan et al., 1991 [19]	60F	Mycobacterium fortuitum	VA shunt	Yes	IT amikacin, amikacin, ofloxacin	Stable, 1 year f/u

**TABLE 1: Overview of reported nontuberculous mycobacterial infections in patients with neurosurgical hardware**

VP, ventriculoperitoneal; P, lumbar-peritoneal; PEEK, polyetheretherketone; DBS, deep brain stimulation; EVD, external ventricular drain; IT, intrathecal; TMP/SMX, trimethoprim-sulfamethoxazole; f/u, follow-up.

The gold standard for diagnosis is AFB culture, which should be ordered based on clinical suspicion as it is often not routinely done. Our microbiology lab uses matrix-assisted laser desorption ionization time-of-flight (MALDI-TOF) technology to identify mycobacteria but the sensitivities take weeks to result at a reference lab.

Immediate surgical hardware removal must be performed. Antibiotic regimens follow American Thoracic Society guidelines on pulmonary NTM [5]. Treatments include parenteral therapy with amikacin and cefoxitin or imipenem with at least one oral agent for at least six months. If there is good clinical response, parenteral regimens are typically discontinued in four to six weeks [20]. Given its rarity, there is no single regimen established for the treatment of CNS infection but three to four drugs should be given until sensitivities become available. Mycobacterium abscessus complex comprises a group of multidrug-resistant NTM, and new treatment regimens are urgently needed [1].

The blood-brain barrier remains a unique problem. IT antibiotics with aminoglycosides may allow theoretically higher doses, and is a safe treatment option; however, there are no efficacy studies to date. Three cases from Table 1 utilized IT amikacin, of which CSF was effectively cleared in two.

## Conclusions

CNS hardware-related NTM infections are rare but are becoming more prevalent. Aggressive treatment should be pursued with immediate hardware removal, parenteral and oral antibiotics as well as IT antibiotics in severe cases. Clinicians should be aware of these organisms in patients with indolent and unusual presentations.

## Additional Information

### Disclosures

**Human subjects:** Consent was obtained by all participants in this study. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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## References

1. Bryant JM, Grogono DM, Rodriguez-Rincon D, et al.: Emergence and spread of a human-transmissible multidrug-resistant nontuberculous Mycobacterium. *Science*. 2016, 354:751-757. [10.1126/science.aaf8156](https://doi.org/10.1126/science.aaf8156)
2. Tunkel AR, Hasbun R, Bhimraj A, et al.: 2017 Infectious Diseases Society of America's clinical practice guidelines for healthcare-associated ventriculitis and meningitis. *Clin Infect Dis*. 2017, 64:34-65.

[10.1093/cid/ciw861](https://doi.org/10.1093/cid/ciw861)

3. Zakrzewski J, Hu K, Neisewander BL, et al.: Mycobacterium fortuitum meningitis: approach to lumboperitoneal shunt infection. *South Med J*. 2019, 112:217-221. [10.14423/SMJ.0000000000000955](https://doi.org/10.14423/SMJ.0000000000000955)
4. Xess AB, Bala K, Panigrahy A, Singh U: Mycobacterium fortuitum as a cause of acute CNS infection in an immune-competent girl undergoing repeated VP shunt surgeries. *BMJ Case Rep*. 2019, 12:e226900. [10.1136/bcr-2018-226900](https://doi.org/10.1136/bcr-2018-226900)
5. Giovannenze F, Stifano V, Scoppettuolo G, et al.: Incidental intraoperative diagnosis of Mycobacterium abscessus meningeal infection: a case report and review of the literature. *Infection*. 2018, 46:591-597. [10.1007/s15010-018-1141-5](https://doi.org/10.1007/s15010-018-1141-5)
6. Moritz DC, Harrington AT, Slavin K, Gomez C, Jarrett OD: Deep brain stimulator infection by a novel rapid growing Mycobacterium. *Acta Neurochir*. 2017, 159:2239-2241. [10.1007/s00701-017-3335-5](https://doi.org/10.1007/s00701-017-3335-5)
7. Baidya A, Tripathi M, Pandey P, Singh UB: Mycobacterium abscessus as a cause of chronic meningitis: a rare clinical entity. *Am J Med Sci*. 2016, 351:437-439. [10.1016/j.amjms.2016.02.009](https://doi.org/10.1016/j.amjms.2016.02.009)
8. Levy ZD, Du V, Chiluwal A, Chalif DJ, Ledoux DE: Ventriculoperitoneal shunt infection with Mycobacterium abscessus: a rare cause of ventriculitis. *World Neurosurg*. 2016, 86:510-511. [10.1016/j.wneu.2015.10.068](https://doi.org/10.1016/j.wneu.2015.10.068)
9. Montero JA, Alrabaa SF, Wills TS: Mycobacterium abscessus ventriculoperitoneal shunt infection and review of the literature. *Infection*. 2016, 44:251-253. <https://doi.org/10.1007/s15010-015-0817-3>
10. Cadena G, Wiedeman J, Boggan JE: Ventriculoperitoneal shunt infection with Mycobacterium fortuitum: a rare offending organism. *J Neurosurg Pediatr*. 2014, 14:704-707. <https://doi.org/10.3171/2014.8.PEDS13677>
11. Lee MR, Sheng WH, Hung CC, Yu CJ, Lee LN, Hsueh PR: Mycobacterium abscessus complex infections in humans. *Emerg Infect Dis*. 2015, 21:1638-1646. [10.3201/2109.141634](https://doi.org/10.3201/2109.141634)
12. Aliabadi H, Osenbach RK: Intrathecal drug delivery device infection and meningitis due to Mycobacterium fortuitum: a case report. *Neuromodulation*. 2008, 11:311-314. [10.1111/j.1525-1403.2008.00181.x](https://doi.org/10.1111/j.1525-1403.2008.00181.x)
13. Uche CS, Silibovsky R, Jungkind D, Measley R: Ventriculoperitoneal shunt-associated Mycobacterium goodii infection. *Infect Dis Clin Pract*. 2008, 16:129-130. [10.1097/IPC.0b013e318142cbae](https://doi.org/10.1097/IPC.0b013e318142cbae)
14. Viswanathan R, Bhagwati SN, Iyer V, Newalkar P: Ventriculo-peritoneal shunt infection by Mycobacterium fortuitum in an adult. *Neurol India*. 2004, 52:393-394.
15. Quinn JV, Steele RW: Ventriculitis following a neurosurgic procedure. *Clin Pediatr (Phila)*. 2002, 41:439-441. [10.1177/000992280204100610](https://doi.org/10.1177/000992280204100610)
16. Midani S, Rathore MH: Mycobacterium fortuitum infection of ventriculoperitoneal shunt. *South Med J*. 1999, 92:705-707. [10.1097/00007611-199907000-00009](https://doi.org/10.1097/00007611-199907000-00009)
17. Madaras-Kelly KJ, DeMasters TA, Stevens DL: Mycobacterium fortuitum meningitis associated with an epidural catheter: case report and a review of the literature. *Pharmacotherapy*. 1999, 19:661-666.
18. Flor A, Capdevila JA, Martin N, Gavalda J, Pahissa A: Nontuberculous mycobacterial meningitis: report of two cases and review. *Clin Infect Dis*. 1996, 23:1266-1273. [10.1093/clinids/23.6.1266](https://doi.org/10.1093/clinids/23.6.1266)
19. Chan KH, Mann KS, Seto WH: Infection of a shunt by Mycobacterium fortuitum: case report. *Neurosurgery*. 1991, 29:472-474. [10.1097/00006123-199109000-00028](https://doi.org/10.1097/00006123-199109000-00028)
20. Griffith DE, Aksamit T, Brown-Elliott BA, et al.: An official ATS/IDSA statement: diagnosis, treatment, and prevention of nontuberculous mycobacterial diseases. *Am J Respir Crit Care Med*. 2007, 175:367-416. [10.1164/rccm.200604-571ST](https://doi.org/10.1164/rccm.200604-571ST)