Post-neurosurgical meningitis

- Aztreonam plus ceftazidime-avibactam for post-neurosurgical meningitis due to Stenotrophomonas maltophilia
- Microbiology and long-term outcomes in community-acquired, nosocomial and post-neurosurgical meningitis with positive bacterial culture in Ontario, Canada: A population-based cohort study
- A sensitive method for the profiling of phenyl- and indole-containing metabolites in blood serum and cerebrospinal fluid samples of patients with severe brain damage using ultra-high-pressure liquid chromatography-tandem mass spectrometry
- Cerebrospinal fluid profiles of targeted metabolomics on neurotransmitters in patients with post-neurosurgical bacterial meningitis
- Treatment Options for Nosocomial Ventriculitis/Meningitis: A Case Report and Review of the Literature
- Cerebrospinal Fluid Analysis in Patients with Post-neurosurgical Procedures: Meningitis vs. Non-meningitis
- YKL-40 levels in cerebrospinal fluid serve as a diagnostic biomarker for post-neurosurgical bacterial meningitis in patients with stroke
- Risk Assessment and Recommended Approaches to Optimize Infection Control and Antibiotic Stewardship to Reduce External Ventricular Drain Infection: A Single-Center Study

---

Post-neurosurgical meningitis is a serious and potentially life-threatening condition that can develop after a neurosurgical procedure. Meningitis is the inflammation of the meninges, the protective membranes that cover the brain and spinal cord. When it occurs as a complication of neurosurgery, it is referred to as post-neurosurgical or postoperative meningitis.

Key points

Causes: Post-neurosurgical meningitis can be caused by various microorganisms, including bacteria, viruses, or fungi. The most common cause is bacterial infection, often due to contamination during surgery or the presence of pre-existing infections.

Risk Factors: Several factors can increase the risk of developing post-neurosurgical meningitis, including the type of surgery, the duration of surgery, the presence of foreign objects (such as a shunt or drain), and the overall health of the patient.

Symptoms: The symptoms of post-neurosurgical meningitis can be similar to those of other types of meningitis and may include fever, severe headache, stiff neck, photophobia (sensitivity to light), nausea, vomiting, and altered mental status. These symptoms can develop within days to weeks after the surgery.

Diagnosis: Diagnosis typically involves a combination of clinical evaluation, cerebrospinal fluid (CSF) analysis (via lumbar puncture), blood tests, and imaging studies (such as CT or MRI scans). CSF analysis is crucial for confirming the presence of infection and identifying the causative microorganism.

Treatment: Prompt treatment is essential to manage post-neurosurgical meningitis. The choice of antibiotics or antifungal medications depends on the specific pathogen responsible for the infection, which is determined through CSF analysis. Treatment may involve hospitalization, intravenous antibiotics or antifungals, and supportive care.

Prevention: Preventing post-neurosurgical meningitis involves meticulous surgical techniques to minimize the risk of contamination, the use of prophylactic antibiotics in some cases, and careful postoperative monitoring. Patients with certain risk factors may be more closely monitored for signs of infection.

Prognosis: The prognosis for individuals with post-neurosurgical meningitis varies depending on factors such as the underlying cause, the timeliness of treatment, and the patient's overall health. Early diagnosis and appropriate treatment are critical for a better outcome.

Complications: If not treated promptly, post-neurosurgical meningitis can lead to severe complications, including brain abscesses, hydrocephalus, and long-term neurological deficits.

It's important to note that post-neurosurgical meningitis is a rare but serious condition that requires immediate medical attention. Patients who have undergone neurosurgery and experience symptoms suggestive of meningitis should seek medical care promptly to ensure timely diagnosis and treatment.

Meningitis remains one of the most dreaded complications of neurosurgical procedures and is common in patients with preexisting infection.

1. usual organisms: Coagulase negative staphylococcus, Staphylococcus aureus, Enterobacteriaceae, Pseudomonas sp., pneumococci usually with basilar skull fractures and otorhinologic surgery

2. empiric antibiotics: vancomycin (to cover MRSA), adult 15 mg/kg q 8-12 hours to achieve trough 15-20mg/dl+cefipime 2 gm IVq 8 hrs

3. if severe PCN allergy, use aztreonam 2gm IV q6-8Hor ciprofloxacin 400mgIV q 8h

4. if severe infection, consider intrathecal therapy delivered daily (use only preservative free drug)

- vancomycin
- tobramycin/gentamicin
- amikacin
- colistin

5. streamline ABXbased on sensitivities,e.g.if organism turns out to be MSSA,change vancomycin oxacillin or nafcillin.

For suspected CSF fistula: usual organisms: streptococci;

Immunocompromised host (e.g. AIDS)

a) usualorganisms:asabovePLUSCryptococcusneoformans,M.tuberculosis,HIVasepticmen- ingitis, L.

monocytogenes

b) empiric antifungal agents for cryptococcal meningitis: Induction therapy: Liposomal ampho- tericin B3-4mg/kgIVdaily+flucytosine25mg/kgPOQIDfor at least 2 weeksfollowed by

c) Consolidation therapy: fluconazole 400 mg PO daily for at least 8 weeks followed by

d) Chronic maintenance therapy: fluconazole 200 mg PO daily

Post-neurosurgical meningitis usually occurs in the autumn and winter of the year in Beijing Tian Tan Hospital, Capital Medical University, Beijing, China;. Gram-positive organisms, which are sensitive to compound sulfamethoxazole and vancomycin, are the most common causative pathogens of post-neurosurgical meningitis in the northern mainland of China [1)].

Postoperative meningitis is a serious complication occurring after neurosurgical interventions.

Meningitis after surgery is still a serious complication that requires preventative intervention. The clinical outcome of patients with postoperative meningitis after neurovascular surgery is not still satisfactory [2)].

Most post-neurosurgical meningitis research has been focused on large cohorts with numerous cases followed over several years. However, the characteristics of post-neurosurgical meningitis in an entire single year are still unclear, and knowledge of these characteristics might influence the selection of appropriate antibiotics and therapeutic strategies for the successful management of this disease.

Epidemiology

Post-neurosurgical meningitis usually occurs in the autumn and winter of the year in the Beijing Tian Tan Hospital, Capital Medical University, Beijing, China hospital [3)].

Etiology

Gram positive organisms, which are sensitive to compound sulfamethoxazole and vancomycin, are the most common causative pathogens of post-neurosurgical meningitis in the northern mainland of China [4)].

In children Gram-positive bacteria are the main pathogens causing post-neurosurgical bacterial meningitis; Gram-negative bacterial meningitis are more likely to occur in autumn and within the first month after surgery. Acinetobacter baumannii has a high resistance rate to carbapenem antibiotics, which should be taken seriously [5)]

Clinical features

The clinical presentation of post-neurosurgical bacterial meningitis in children is atypical. Gram-positive bacteria are the main pathogens causing post-neurosurgical bacterial meningitis; Gram-negative bacterial meningitis are more likely to occur in autumn and within the first month after surgery. Acinetobacter baumannii has a high resistance rate to carbapenem antibiotics, which should be taken seriously [6)]

Diagnosis

Post-neurosurgical meningitis diagnosis.

Treatment

Post-neurosurgical meningitis treatment

Retrospective observational studies

Postoperative intracranial neurosurgical infections (PINI) complicate < 5% neurosurgeries. Scarce attention was dedicated to the extension and characteristics of its antimicrobial management considering their high morbidity, not negligible mortality, delayed hospital stay and increased healthcare costs.

They analyzed retrospectively (2014-2023) 162 PINI from eight Spanish tertiary teaching hospitals.

Elective clean craniotomies after tumor or vascular causes were the leading procedures. Epidural abscess (24.7%), scalp infections (19.8%), postsurgical meningitis (16.7%) and cranioplasty infections (16.7%) were the most frequent PINI. Gram negative bacteria (38.6%) and Staphylococcus spp (28.6%) were the predominant isolates. Overall 85.2% patients underwent pus drainage, mostly by craniotomy (40.3%). Interestingly 34% were already receiving antibiotics for extracranial infections before developing PINI while 16.8% did not receive pre-operative antibiotic prophylaxis. In total 77.2% patients started a combined intravenous (IV) antimicrobial therapy, of which 85.2% switched after 5 days to a second-line IV antibiotic regimen, in 41.3% cases combined, after pus culture results, for a median of 21 days. Overall 61.1% patients continued on oral antimicrobials after hospital discharge, 30.3% as a combined regimen, for a median of 42 days. Complete cure was obtained in 81.5% cases, while 11.1% relapsed, 7.4% failed to cure and 6.8% died after PINI complications. In the multivariate analysis oral antimicrobial therapy after hospital discharge ($p = 0.001$) was significantly associated with PINI cure with no effect on survival.

They conclude that an extended 6 weeks sequential IV and oral antimicrobial therapy in addition to neurosurgical correction increases PINI cure rate with no effect on survival [7)]

Case series

A cohort analysis was performed using the clinical database in Beijing Tiantan Hospital and Capital Medical University. Data were collected on patients with the diagnosis of post-neurosurgical meningitis (n = 3931) during 2012.01 to 2022.04. The microbial distribution, types of antibiotic prophylaxis, and 42 and 90 days survival analysis of AP patients were evaluated using probable statistical methods. Independent risk factors for mortality were established by constructing a logistic regression analysis.

A total of 1,190 patients were included in this study, Klebsiella pneumoniae, Acinetobacter baumannii, and Staphylococcus aureus occupied the highest proportion. Of them, 929 cases received AP, cefuroxime and ceftriaxone are the most frequent used antibiotics. In addition, We found that PNM patients without AP significantly increased the 42 days and 90 days all-cause mortality rates. The use of different levels of AP did not improve patient outcomes, and ICU admission and assisted mechanical ventilation (AMV) were identified as independent mortality risk factors for PNM patient received AP.

AP plays an important role in the prognosis of PNM patients and has a significant function in improving prognosis. The prevention of PNM with antibiotics prior to neurosurgery should be emphasized in clinical practice, and appropriate selection of antibiotics is necessary to prevent the occurrence of infection and inhibit the emergence of antibiotic-resistant bacteria [8].

A single-centered retrospective cohort study enrolled post-neurosurgical patients with gram negative bacterial meningitis/encephalitis at a tertiary-care university hospital between 2012 and 2022. The risk factors for 28-day mortality were evaluated using multivariate Cox analysis. FUCC-related risk factors were also analyzed.

Among the 844 enrolled patients, 504 (59.7%) underwent follow-up cerebrospinal fluid cultures (FUCCs), and FUCC was found to be associated with lower rates of both all-cause (hazard ratio (HR) 0.391; 95% confidence interval (CI), 0.235-0.651; p<0.001) and attributable mortality (HR 0.463; 95% CI, 0.239-0.897; p=0.023) in Post-neurosurgical patients diagnosed with Gram-negative bacterial meningitis/encephalitis. Moreover, the results of the study underscored that patients with persistent gram-negative bacterial meningitis/encephalitis had a lower all-cause/attributable short-term survival rate according to 28-day mortality Kaplan-Meier analysis (P=0.001/0.006).

Performing follow-up cerebrospinal fluid cultures has been demonstrated to lower mortality rates in Post-neurosurgical patients suffering from Gram-negative bacterial meningitis/encephalitis. The higher mortality rate observed in patients with persistent gram-negative bacterial meningitis/encephalitis suggests that performing follow-up cerebrospinal fluid cultures is a crucial component of proper patient care and management, and is therefore recommended for use by clinicians as a standard practice. This finding underscores the significance of consistent implementation of follow-up cerebrospinal fluid cultures in the management and prognosis of patients with Post-neurosurgical infections [9]

A retrospective cohort study was conducted in 18 tertiary-care academic hospitals Turkey, India, Egypt and Romania. We extracted data and outcomes of all patients with post-neurosurgical

meningitis cases fulfilling the study inclusion criteria and treated with empirical therapy between December 2006-September 2018.

Results: Twenty patients in the cefepime + vancomycin-(CV) group, 31 patients in the ceftazidime + vancomycin-(CFV) group, and 119 patients in the meropenem + vancomycin-(MV) group met the inclusion criteria. The MV subgroup had a significantly higher mean Glasgow Coma Score, a higher rate of admission to the intensive care unit within the previous month, and a higher rate of antibiot herapy within the previous month before the meningitis episode ($p < 0.05$). Microbiological success on Day 3-5, end of treatment (EOT) clinical success (80% vs. 54.8%% vs 57.9%), and overall success (EOT success followed by one-month survival without relapse or reinfection 65% vs. 51.6% vs. 45.3%), EOT all cause mortality (ACM) and day 30 ACM (15% vs. 22.6% vs. 26%) did not differ significantly ($p > 0.05$) among the three cohorts. No regimen was effective against carbapenem-resistant bacteria, and vancomycin resulted in an EOT clinical success rate of 60.6% in the methicillin-resistant staphylococci or ampicillin-resistant enterococci subgroup (n = 34).

The study showed no significant difference in terms of clinical success and mortality among the three treatment options. All regimens were ineffective against carbapenem-resistant bacteria. Vancomycin was unsuccessful in approximately 40% of cases involving methicillin-resistant staphylococci or ampicillin-resistant enterococci [10)]

1)
Tian R, Hao S, Hou Z, Gao Z, Liu B. The characteristics of post-neurosurgical bacterial meningitis in elective neurosurgery in 2012: A single institute study. Clin Neurol Neurosurg. 2015 Sep 5;139:41-45. doi: 10.1016/j.clineuro.2015.09.002. [Epub ahead of print] PubMed PMID: 26364156.
2)
Inoue T, Shimizu H, Fujimura M, Sato K, Endo H, Niizuma K, Sakata H, Tominaga T. Risk factors for meningitis after craniotomy in patients with subarachnoid hemorrhage due to anterior circulation aneurysms rupture. Clin Neurol Neurosurg. 2015 Nov 1;139:302-306. doi: 10.1016/j.clineuro.2015.10.029. [Epub ahead of print] PubMed PMID: 26562195.
3) , 4)
Tian R, Hao S, Hou Z, Gao Z, Liu B. The characteristics of post-neurosurgical bacterial meningitis in elective neurosurgery in 2012: A single institute study. Clin Neurol Neurosurg. 2015 Sep 5;139:41-45. doi: 10.1016/j.clineuro.2015.09.002. [Epub ahead of print] PubMed PMID: 26364156.
5) , 6)
Luo LJ, Wang J, Chen WJ, Zhou YJ, Zhou YJ, Song YH, Shen N, Cao Q. [Clinical features of post-neurosurgical bacterial meningitis in children]. Zhonghua Er Ke Za Zhi. 2023 Aug 2;61(8):690-694. Chinese. doi: 10.3760/cma.j.cn112140-20230424-00295. PMID: 37528008.
7)
Asensi V, Vázquez-Fernández C, Suárez-Díaz S, Asensi-Díaz E, Carrasco-Antón N, García-Reyne A, Panero I, Muñoz MV, Guerra JM, Arístegui J, Sepúlveda MA, García-Calvo X, Dueñas C, Biosca M, Chiminazzo V, Collazos J. Extended sequential intravenous and oral antimicrobial therapy improves cure rate in postoperative intracranial neurosurgical infections: a Spanish multicenter retrospective study. BMC Infect Dis. 2024 Nov 26;24(1):1345. doi: 10.1186/s12879-024-10204-7. PMID: 39587499.
8)
Zheng G, Shi Y, Sun J, Wang S, Li X, Lv H, Zhang G. Effect of antibiotic prophylaxis in the prognosis of Post-neurosurgical meningitis patients. Eur J Med Res. 2023 Oct 4;28(1):396. doi: 10.1186/s40001-023-01399-7. PMID: 37794524.
9)
Sun J, Shi Y, Ding Y, Wang S, Qian L, Luan X, Li G, Chen Y, Li X, Lv H, Zheng G, Zhang G. Effect of Follow-Up Cerebrospinal Fluid Cultures in Post-Neurosurgical Patients' Outcome with Gram-Negative Bacterial Meningitis/Encephalitis. Infect Drug Resist. 2023 Sep 22;16:6285-6295. doi: 10.2147/IDR.S425799. PMID: 37771842; PMCID: PMC10522782.

10)
Sipahi OR, Akyol D, Ormen B, Cicek-Senturk G, Mermer S, Onal U, Amer F, Saed MA, Ozdemir K, Tukenmez-Tigen E, Oztoprak N, Altin U, Kurtaran B, Popescu CP, Sakci M, Suntur BM, Gautam V, Sharma M, Kaya S, Akcil EF, Kaya S, Turunc T, Ergen P, Kandemir O, Cesur S, Bardak-Ozcem S, Ozgiray E, Yurtseven T, Erdem HA, Sipahi H, Arda B, Pullukcu H, Tasbakan M, Yamazhan T, Aydemir S, Ulusoy S. Empirical cefepime+vancomycin versus ceftazidime+vancomycin versus meropenem+vancomycin in the treatment of healthcare-associated meningitis: results of the multicenter ephesus study. BMC Infect Dis. 2023 Sep 28;23(1):639. doi: 10.1186/s12879-023-08596-z. PMID: 37770836; PMCID: PMC10540455.