

Meningitis and Ventriculitis – Healthcare Associated

Healthcare-associated meningitis or ventriculitis can occur after head trauma, invasive procedures such as placement of external ventricular drainage (EVD) shunts, CSF drains, intrathecal infusion pumps, deep brain stimulation hardware, or after neurosurgical procedures. They are associated with different etiological agents and pathogenic mechanisms than community-acquired CNS infections and can be difficult to diagnose as surgery and/or trauma can induce CSF abnormalities. The frequency of these infections can be reduced by the appropriate administration of pre-op prophylactic antibiotics and excellent post-op care including application of chlorhexidine-containing dressings for EVDs.

COMMON ETIOLOGIC AGENTS:

Gram-positive cocci: Coagulase-negative staphylococci (eg. *S. epidermidis*) and *S. aureus*

Gram-positive bacilli: *C. acnes* (formerly *P. acnes*)

Gram-negative bacilli: *Enterobacteriales* (eg: *E. coli*, *Enterobacter spp*) and *P. aeruginosa*

SUGGESTIVE SIGNS/SYMPTOMS

CSF shunt/drain	<ul style="list-style-type: none">- New headache, nausea, lethargy- Change in mental status/decreased level of consciousness- Fever- Erythema/tenderness over the subcutaneous shunt tubing- Signs and symptoms at distal portion of shunt (i.e. peritonitis, pleuritis)- Purulent drainage or positive culture from EVD or externalized VP shunt
Neurosurgery/Head trauma	<ul style="list-style-type: none">- New headache, fever- Change in mental status/decreased level of consciousness- Evidence of meningeal irritation- Seizures

DEFINITION OF HEALTHCARE ASSOCIATED MENINGITIS/VENTRICULITIS

An organism cultured from the CSF **OR** at least **two** of the following:

- fever >38°C or headache
- meningeal signs
- cranial nerve signs
- signs of dura-arachnoid enhancement, subdural empyema, or ventriculitis on brain imaging

AND at least **one** of the following:

- Increased CSF white blood cell count, elevated CSF protein, and/or decreased CSF glucose
- Organisms seen on a CSF Gram stain
- Organisms cultured from the blood
- Positive non-culture diagnostic test from the CSF, blood, or urine

IMPORTANT DIAGNOSTIC CONSIDERATIONS:

- Collect blood and CSF **EMERGENTLY** for microbiology prior to starting antibiotics
- **Neuroimaging modalities** helpful to detect extension of infection (eg. subdural empyema, brain abscess)
- **Complete removal of infected catheter, drain or shunt is strongly recommended**, and send components to Microbiology laboratory for culture
- **Infectious Disease (ID)** service consultation recommended

EMPIRIC PHARMACOLOGIC MANAGEMENT¹

Vancomycin² 25 mg/kg loading dose IV x 1 (max 3 g) then 15 mg/kg IV q8h **PLUS**
Meropenem 2 g IV q8h (After initial bolus, extended infusion over 3 h preferred)

If severe hypersensitivity reaction to meropenem³:

Vancomycin² 25 mg/kg loading dose IV x 1 (max 3 g) then 15 mg/kg IV q8h **PLUS**
Ciprofloxacin⁴ 400 mg IV q8h **OR Aztreonam⁵** 2g IV q8h [if ciprofloxacin is contra-indicated]

If severe hypersensitivity reaction to Vancomycin (extremely rare):

Meropenem 2g IV q8h (After initial bolus, extended infusion over 3 h preferred) **PLUS Linezolid⁶**
 600mg IV q12h

¹ Dosing assume normal renal function and weight; adjust if renal dysfunction and/or obesity

² See Vancomycin TDM guideline; consult pharmacy.

³ Anaphylaxis or Steven-Johnson syndrome/Toxic epidermal necrolysis to carbapenems. If anaphylaxis to penicillin, cross-allergenicity to carbapenems is <1%

⁴ Ciprofloxacin: can be associated with serious adverse events including CNS toxicity (agitation to seizures), arterial dissection, tendon rupture, muscle weakness, QT prolongation and severe diarrhea

⁵ Aztreonam: accessible through the SAP only

⁶ Linezolid: multiple drug-drug interactions possible, consult pharmacy

Modify empiric (primary) regimen based on culture and susceptibility results.

For drug-resistant and difficult to treat organisms: CONSULT ID

ETIOLOGIC AGENT	MINIMUM DURATION of Treatment*
Coagulase-negative staphylococci (especially <i>S. epidermidis</i>) <i>Propionibacterium acnes</i>	10 days after removal of foreign material
Gram-negative bacilli (including <i>Pseudomonas aeruginosa</i>) <i>Staphylococcus aureus</i>	14 days after removal of all foreign material (can be extended to 21 days in some cases)

*DURATION of treatment:

- In patients with repeatedly positive CSF cultures despite appropriate antibiotic therapy, treatment should be continued for 10–14 days after the last positive culture if hardware was removed
- Many neurosurgical procedures leave no foreign material; duration of treatment may be prolonged if ventriculitis, subdural empyema, brain abscess or cranial osteomyelitis are present or suspected.
- Consult ID for timing of re-insertion of foreign material

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