# Central Nervous System Infections

## MICROBIOLOGY

- **Community-acquired meningitis:** *S. pneumoniae*, *N. meningitidis*, *H. influenzae* most common.
  - **Vancomycin no longer recommended:** Nearly 100% of invasive *S. pneumoniae* isolates in FH are ceftriaxone susceptible using meningitis breakpoints.
  - **Listeria risk elevated if:** pregnant, age over 50, immunocompromised, renal dialysis, or diabetes mellitus.
  - **Many causes of viral/aseptic meningoencephalitis:** HSV, VZV, Enterovirus, HIV, Syphilis
- **Community-acquired brain abscess:** viridans group Streptococci and anaerobes most common. *S. aureus* seen in setting of concomitant bacteremia or endocarditis.
- **Healthcare-associated meningitis:** *S. aureus*, coagulase-negative Staphylococci, C. *acnes*, *Enterobacteriaciae*, *Pseudomonas*, *Acinetobacter*.

## DIAGNOSIS

- Nearly all patients with bacterial meningitis have **at least one** of fever, neck stiffness, or altered mental state.
- **Collect blood cultures PRIOR to initiation of antimicrobial therapy whenever possible**
- Optimally, collect CSF PRIOR to initiation of antimicrobial therapy whenever possible, **but do not delay antimicrobials greater than 1 hour, especially in setting of a CT scan.**
  - *When is CT Head needed before LP?*
    Immunocompromise, history of CNS disease, new onset seizure, papilledema, abnormal level of consciousness, or focal neurologic deficit.

### CSF Interpretation

| | WBC (cells/microL) | | | Glucose (mmol/L) | | Protein (g/L) | |
|---|---|---|---|---|---|---|---|
| | **5-100** | **100-1000** | **>1000** | **<0.6** | **0.6-2.5** | **0.5-2.5** | **>2.5** |
| **Bacterial** | Rare | YES | YES | YES | YES | YES | YES |
| **Viral** | YES | YES | Rare | NO | Rare | YES | Rare |

- CSF in bacterial meningitis is typically neutrophil predominant (>80%)
- CSF in viral meningitis may be neutrophil predominant in first 24hrs, then becomes lymphocyte predominant
- CSF in *Listeria* meningitis is typically lymphocyte predominant
- In setting of hyperglycemia, a CSF-to-serum glucose of <0.6 is considered low

## EMPIRIC THERAPY

| **Classification** | |
|---|---|
| INSTITUTE **DROPLET PRECAUTIONS** FOR ANY SUSPECTED MENINGITIS | |
| **Community-Acquired Meningitis** | **ceftriaxone** 2 g IV q12h AND **dexamethasone** 10 mg IV q6h (give before or with first dose of antibiotics)<br><br>If severe cephalosporin allergy: **meropenem** 2 g IV q8h AND **dexamethasone** 10 mg IV q6h (give before or with first dose of antibiotics)<br><br>If Listeria suspected ADD **ampicillin** 2 g IV q4h<br>*If severe penicillin allergy:* ADD **TMP-SMX** 5 mg/kg of TMP IV q6h<br><br>If viral meningoencephalitis suspected ADD **acyclovir** 10 mg/kg IV q8h |
| **Community-Acquired Brain Abscess** | **ceftriaxone** 2 g IV q12h AND **metronidazole** 500 mg IV/PO q8h |
| **Healthcare-Associated Meningitis** | **meropenem** 2 g IV q8h AND **vancomycin** IV |

*Doses may require adjustment in renal insufficiency.*
*For vancomycin dosing, refer to "Vancomycin Dosing and Therapeutic Monitoring"*

**DIRECTED THERAPY AND DURATION**

| Classification | | Duration |
|---|---|---|
| **DROPLET PRECAUTIONS** can be discontinued after 24 hours of effective therapy for bacterial meningitis | | |
| **Community-Acquired Meningitis** | | |
| *S. pneumoniae* | Penicillin-susceptible: **penicillin G** 4 million units IV q4h<br>Penicillin-resistant, ceftriaxone-susceptible: **ceftriaxone** 2 g IV q12h<br>Ceftriaxone-resistant: **ceftriaxone** 2 g IV q12h AND **vancomycin** IV<br><br>Adjunctive **dexamethasone** 10 mg IV q6h | 10-14 days<br><br><br><br>4 days |
| *N. meningitidis* | Penicillin-susceptible: **penicillin G** 4 million units IV q4h<br>Penicillin-resistant: **ceftriaxone** 2 g IV q12h | 7 days |
| *H. influenzae* | Ampicillin-susceptible: **ampicillin** 2 g IV q4h<br>Ampicillin-resistant: **ceftriaxone** 2 g IV q12h | 7 days |
| *Listeria* | **ampicillin** 2 g IV q4h<br>*If penicillin allergy:* **TMP-SMX** 5 mg/kg of TMP IV q6h<br>Consider synergy with **gentamicin** 1.7 mg/kg IV q8h (ID consult recommended) | 21 days<br><br>7+ days |
| *HSV Encephalitis and/or Meningitis* | HSV Encephalitis: MUST receive antiviral therapy<br>**acyclovir** 10 mg/kg IV q8h<br>HSV Meningitis without Encephalitis: Often resolves without antiviral therapy<br>**acyclovir** 10 mg/kg IV q8h OR **valacyclovir** 1 g PO TID | <br>14-21 days<br><br>10-14 days |
| **Community-Acquired Brain Abscess** | | |
| Directed therapy for brain abscess should be done with expert guidance. Uncultured organisms may be present. | | |
| **Healthcare-Associated Meningitis** | | |
| Infectious Diseases consultation recommended, especially if drains or hardware in place. | | |
| *Staphylococci, methicillin-susceptible* | **cloxacillin** 2 g IV q4h<br>If penicillin allergy: **vancomycin** IV | 10-21 days |
| *Staphylococci, methicillin-resistant* | **vancomycin** IV | 10-21 days |
| *C. acnes* | **penicillin G** 4 million units IV q4h | 10-14 days |
| *Gram-negative bacilli e.g., E. coli, Klebsiella* | **ceftriaxone** 2 g IV q12h<br>If ESBL or AmpC-producing: **meropenem** 2 g IV q8h | 10-21 days |
| *Pseudomonas* | **meropenem** 2 g IV q8h | 10-21 days |
| *Acinetobacter* | **meropenem** 2 g IV q8h | 10-21 days |

*Doses may require adjustment in renal insufficiency.*
*For vancomycin dosing, refer to "Vancomycin Dosing and Therapeutic Monitoring"*

**Dexamethasone**

- Dexamethasone should be given before or at the time of antibiotic administration. If antibiotics have already been administered, starting dexamethasone is unlikely to provide clinical benefit.
- In adults, adjunctive dexamethasone has only shown to provide benefit (reduced mortality) for *Streptococcus pneumoniae* meningitis. Therefore, **dexamethasone should only be continued if pneumococcal meningitis is proven.**