

MENINGITIS

Meningitis is inflammation of the protective membranes surrounding the brain and spinal cord, most commonly caused by viral or bacterial infection. Other sources of meningitis include fungal or parasitic infections and non-infectious causes such as injury, cancer, or drugs. Patients with meningitis classically present with fever, signs of meningism (headache, neck stiffness, photophobia) and altered mental status. Rapid assessment and prompt antimicrobial therapy is typically indicated when there is suspicion of bacterial infection and risk of sepsis.

Aetiology and Pathogenesis

- Meningitis is inflammation of the meninges.
- May be caused by viral, bacterial or fungal infection. Can also be drug-induced.
- The **meninges**, which refers to the membranous layer of the brain, is consequently broken down. This is due to:
 - antibacterial inflammation
 - or direct action by the pathogen
- This results in the **common symptoms** of meningitis, such as brain abscesses or symptoms of cerebral oedema and increased intracranial pressure.
- Common pathogens:
 - Bacterial: *Streptococcus pneumoniae*, *Haemophilus influenzae type b (Hib)*, *Neisseria meningitidis* (cause of meningococcal meningitis)
 - Viral: Human enteroviruses
 - Fungal: *Cryptococcus species*

Risk Factors:

- Predisposing infection (sinusitis, otitis)
- Trauma, CSF leak
- Bacteraemia/sepsis

- Immunocompromised
- Close-contact with an infected person

Presentation

Symptoms of meningitis include:

- neck stiffness
- severe and frequent headaches
- muscle pain
- increased sensitivity to light (photophobia)
- fever

Signs of meningitis include:

- Rash → mainly associated with meningococcal meningitis
- Kernig's sign
 - specific but not sensitive
 - pain on extension of leg when hip is flexed
- Brudzinski's sign → passive flexion of neck causes flexion of hips

Diagnosis

Laboratory Tests

- Lumbar Puncture

	Bacterial	Viral	Fungal
CSF Culture	+	-	-
WCC	Polymorphs	Lymphocytes	Lymphocytes
Glucose	Low	Normal	Low
Protein	High	Normal/elevated	High
Lactate	>35mg/dL indicates bacterial		

- **Blood cultures** → identify causative organisms
 - ideally taken prior to antibiotics but still perform if antibiotics have been taken prior to admission

Imaging

- **MRI**
 - MRI scans of the brain may show inflammation or swelling of segments of the brain

Differential Diagnosis

- **Encephalitis:** indicated by change in neurological function (change in speech, focal neurological signs). Patients with meningitis may be confused or drowsy but should not have abnormal cerebral function.
 - CSF analysis: may be normal or have high protein/low glucose/high RBC

- MRI brain: variety of findings dependent on aetiology (i.e. hyperdense lesions)

Treatment

Main aims:

- I. Initial differentiation of bacterial meningitis from other diagnoses (viral/aseptic meningitis, encephalitis, subarachnoid haemorrhage).
- II. Apply appropriate isolation protocols.
- III. Stabilise the patient as needed (fluid resuscitation, airway management).
- IV. Lumbar puncture for CSF analysis is key to diagnosis and directed therapy for bacterial meningitis.
- V. Ideally obtain MC&S results, CSF, blood cultures before starting empirical antibiotic therapy.
- VI. Early empirical antibiotics are appropriate when clinical suspicion of bacterial meningitis is high; ideally within 60 minutes of presentation to hospital.
- VII. Do not withhold treatment if there is significant delay in performing investigations.
- VIII. If neuroimaging is indicated prior to LP: obtain blood cultures, start antibiotics immediately, then proceed with CT and LP.
- IX. Tailor antimicrobial therapy once pathogen has been identified.

Treatment settings and approach:

Prehospital management of suspected meningitis

- Transfer patient to hospital urgently if suspecting meningitis.
- If meningococemia is suspected in the community setting, give an immediate dose of ceftriaxone or benzylpenicillin.
- If possible, collect blood samples for culture, swabs or aspirates of skin lesions (for *Neisseria meningitidis*) before giving



antibiotics. Send all samples with the patient to hospital.

Empirical therapy for meningitis in hospital

- If the patient has not received ceftriaxone or benzylpenicillin before hospital, and MC&S results are unknown, give empirical antibiotics and dexamethasone.
- Dexamethasone (corticosteroid therapy) improves outcomes for adults with *Streptococcus pneumoniae* (pneumococcal) meningitis (mortality) and children with *Haemophilus influenzae* type b (Hib) meningitis (hearing loss).
- If corticosteroids are not available, do not delay antibiotic treatment.

Adults, and children 2 mo or older	<p>Ceftriaxone IV OR Cefotaxime IV</p> <p>PLUS Dexamethasone IV, preferably starting before or with 1st dose of antibiotics; then 6-hourly for 4 days.</p>
Patients older >50 years, immunocompromised, pregnant, debilitated, or with a history of harmful alcohol consumption	<p><i>To treat Listeria monocytogenes (resistant to cephalosporins)</i></p> <p>ADD to the above regimen – Benzylpenicillin IV.</p>

- If *Streptococcus pneumoniae* infection suspected (Gram-positive diplococci seen on Gram stain / pneumococcal antigen assay of CSF is positive / if the patient has known or suspected otitis media or sinusitis):

- ADD vancomycin IV.

- If Gram-positive staphylococci are seen on Gram stain, or if CSF tests are not possible because LP is contraindicated:

- ADD vancomycin IV.

Pathogen-specific therapy

- Directed antimicrobial therapy should be guided by final culture and sensitivity results, as well as local resistance patterns. Consult specific treatment guidelines (eTG).

CSF indicates viral meningitis

- Consider stopping antibiotics and dexamethasone.
- Most cases of viral meningitis can be treated supportively.
- Specific antiviral therapy (aciclovir) is only indicated if *viral encephalitis* is also suspected.
 - Start aciclovir in all patients with suspected acute encephalitis, since Herpes simplex virus (HSV) is the most common treatable cause. Diagnosis of herpes simplex encephalitis is confirmed by viral DNA in CSF.
 - Aciclovir should be discontinued if PCR and antibody tests are negative for Herpes simplex virus (HSV) or Varicella Zoster virus (VSV).

Close contacts

- Check local protocols.
- Post-exposure prophylaxis (clearance antibiotics) may be needed for some close contacts of the patient; with or without immunisation.



- Clearance antibiotics are used to eradicate asymptomatic nasopharyngeal carriage of *Neisseria meningitidis* or *Haemophilus influenzae* type b (Hib) so that susceptible contacts do not develop invasive infection.

N. meningitidis close contacts	Ciprofloxacin OR ceftriaxone OR rifampicin
Hib close contacts	Rifampicin OR ceftriaxone

- Contact management for *Streptococcus pneumoniae* is not typically indicated as close contacts are not usually at increased risk of infection.

Complications

- *Most common* – sensorineural hearing loss (transient or permanent).
- Cerebral edema and elevated ICP.
- Shock.
- Focal neurological deficits.
- Seizures.
- Cognitive impairment.
- Spasticity or paresis.
- Communicating hydrocephalus.
- Cerebrovascular disease.
- *Rare* – brain abscess, subdural empyema, arteritis (risk of cerebral infarction, cerebral venous sinus thrombosis), ventriculitis, cerebritis.
- *Waterhouse-Fridrichsen syndrome*:
 - Commonly associated with meningococcal meningitis; affects small children and asplenic individuals.
 - Coagulopathy triggered by endotoxins which leads to hemorrhagic necrosis of the adrenal glands.

Additional Resources

eTG complete by Therapeutic Guidelines. Meningitis.

<https://tgldcdp-tg-org-au.eu1.proxy.openathens.net/viewTopic?topicfile=meningitis&guidelineName=Antibiotic&topicNavigation=navigateTopic>

AMBOSS. Meningitis.

https://tgldcdp-tg-org-au.eu1.proxy.openathens.net/viewTopic?topicfile=meningitis&guidelineName=Antibiotic&topicNavigation=navigateTopic#toc_d1e64

BMJ Best Practice. Bacterial meningitis in adults.

<https://bestpractice-bmj-com.eu1.proxy.openathens.net/topics/en-gb/3000104>

The Royal Children's Hospital Melbourne.

Clinical Practice Guidelines. Meningitis and encephalitis.

https://www.rch.org.au/clinicalguide/guideline_index/Meningitis_Guideline/

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3. BMJ Best Practice. Bacterial meningitis in adults [Internet]. BMJ Publishing Group; 2020 [updated 2020 July]. Available from: <https://bestpractice.bmj.com/topics/en-gb/3000104>



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