Meningitis

is an inflammation of the tissue layer surrounding the brain and spinal cord, aka. meninges consisting of the dura, arachnoid & pia mater

AETIOLOGY

Infective causes

Bacterial, viral, fungal, tuberculous

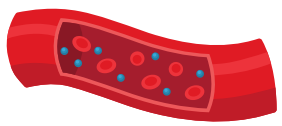
Non-infective causes

Neoplastic disease, drug administration and systemic inflammatory disease

PATHOPHYSIOLOGY

Hematogenous spread

Organisms colonise epithelial surfaces (e.g. respiratory tract, lower genital tract) and enter bloodstream after mucosal invasion, subsequently invading the meninges

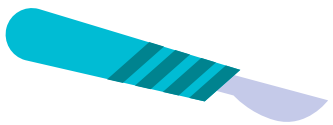


Contiguous spread

Organisms enter CSF via neighbouring anatomic structures (e.g. sinusitis, otitis media)

Direct inoculation

Trauma, neurosurgical complications



Bacterial meningitis is more severe, but less common than viral meningitis

COMMON AETIOLOGY OF BACTERIAL MENINGITIS BY AGE

Neonates

- Group B Streptococcus
- E. coli
- S. pneumoniae
- L. monocytogenes

Babies & young children

- S. pneumoniae
- H. influenzae
- Group B Streptococcus
- N. meningitidis

Teens & young adults

- S. pneumoniae
- N. meningitidis

Older adults

- S. pneumoniae
- Group B Streptococcus
- H. influenzae
- L. monocytogenes
- N. meningitidis

Signs and Symptoms of Meningitis

HISTORY

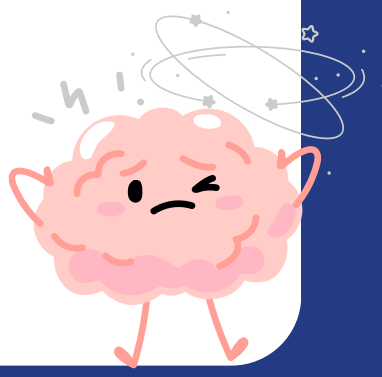
- Headache
- Fever
- Neck stiffness
- Altered mental status

Can be accompanied with:

- Photophobia
- Nausea & vomiting

Concomitant infections:

- Sinusitis or otitis
- Pneumonia



EXAMINATION

Signs of meningeal irritation	Manoeuvre	Positive test	Sensitivity & Specificity
	Place the patient supine with hip flexed at 90 degrees. Attempt to extend the leg at the knee.	Resistance to extension at the knee to >135°or pain in the lower back or posterior thigh.	Low sensitivity (20%-30%) High specificity (85%-95%)
	Place the patient in the supine position and passively flex the head toward the chest.	Flexion of the knees and hips of the patient.	

Also lookout for skin rash!
Petechiae / purpura ⇨ meningococcal meningitis

Investigations for Meningitis

1 BLOODS

- Full blood count with differential
- Blood culture
- Serum electrolytes and glucose ⇨ to determine CSF : serum glucose ratio
- Coagulation studies ⇨ to look for DIVC, esp. if petechiae / purpura noted

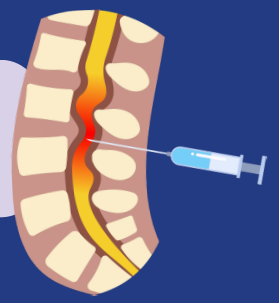
2 LUMBAR PUNCTURE FOR CEREBROSPINAL FLUID ANALYS

Perform LP asap unless contraindicated!
LP is key to diagnosis and directed therapy!

- Cell count and differential
- Protein concentration
- Glucose concentration
- Direct microscopy and gram stain / Ziehl Neelsen stain / Indian ink stain
- Culture ⇨ gold standard for diagnosis of bacterial meningitis
- Others (e.g. rapid antigen tests, PCR)

Investigations for Meningitis

2 LUMBAR PUNCTURE FOR CEREBROSPINAL FLUID ANALYS



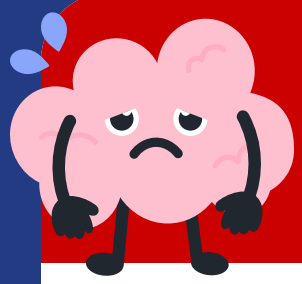
CSF analysis

	Normal	Bacterial	Viral	Fungal	TB
APPEARANCE	Clear	Turbid	Clear	Fibrin Web	Turbid/Viscous
OPENING PRESSURE (cm H2O)	Normal (5-20)	Elevated (>30)	Normal / mildly elevated	Elevated	Elevated
WBC COUNT	Normal	↑ ↑ ↑	↑	↑	↑
CELL DIFFERENTIAL	–	PMNs predominance	Lymphocytes predominance	Lymphocytes predominance	Lymphocytes predominance
PROTEIN (G/L)	0.2 – 0.4	↑ ↑ (> 1)	N / ↑ (< 1)	N / ↑	↑ ↑ (> 1)
GLUCOSE (MMOL/L)	2.5 – 3.5	↓	N	↓	↓
CSF:SERUM GLUCOSE RATIO	0.6	↓ (< 0.4)	N	↓ (< 0.4)	↓ (< 0.4)

Management of Bacterial Meningitis

BACTERIAL MENINGITIS IS A MEDICAL EMERGENCY!

- Early diagnosis and treatment are vital
- Transfer patients to hospital urgently
- Ideally, obtain microbiological samples before starting empirical antibiotic therapy
- Do not withhold treatment if there is significant delay in performing investigations



EMPIRICAL ANTIBIOTICS FOR MENINGITIS

IV ceftriaxone or cefotaxime + IV dexamethasone

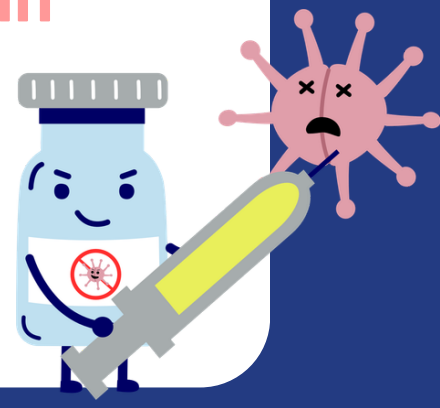
Current evidence favours early treatment with dexamethasone to improve outcomes in adults with strep. pneumoniae meningitis (mortality) and children with Hib meningitis (hearing loss)

If at risk of L. monocytogenes infection

Add IV benzylpenicillin

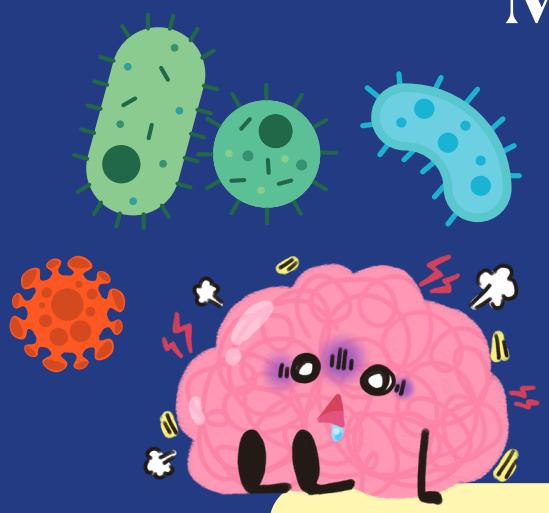
If at risk of penicillin & cephalosporin-resistant S. pneumoniae infection

Add IV vancomycin



Source: eTG

Management Flow chart



Suspected bacterial meningitis

↓

Collect blood for culture

↓

Can a lumbar puncture be done urgently?

Mnemonic FAILS
Focal neurological deficit
Altered mental status
Increased ICP / Immunocompromised
Lesion in brain / skin near LP site
Seizures

Are there contraindications to LP?

- Anticoagulant therapy
- Bleeding diathesis
- Suspected DIVC (including evolving petechial/purpuric rash)
- Localised infection overlying lumbar region
- Chiari malformation
- Significant cardiorespiratory compromise

Are there indications for head CT before LP?

Possible raised ICP:

- Focal neurological signs
- Papilloedema
- New-onset seizures (last 7 days)
- Rapidly deteriorating conscious state

Possible alternative diagnosis:

- Suspected focal CNS disease
- Subarachnoid haemorrhage
- Immunocompomised (↑ risk of mass lesions)

NO → **Perform LP**

YES ← Do not delay empirical therapy while waiting for ix!

Empirical therapy: IV ceftriaxone + dexamethasone
Start asap, ideally within 60 mins of presentation to hospital!

Modify therapy according to C&S results

Obtain head CT

- **No signs of ↑ ICP** → **Perform LP**
- **Signs of ↑ ICP** → **Continue empirical therapy until pathogen detected then modify therapy accordingly**

Take home message

LP is contraindicated in ↑ ICP due to the risk of brain herniation ⇨ rule out ↑ ICP with head CT

Do not delay empirical antibiotics while waiting for LP or scans to be performed

Source: eTG

Test your Knowledge!

An 18 year old male student has been home from university for 3 days, during which time he has become increasingly drowsy. He is able to be roused but is disoriented. He has a temperature of 39°C, has marked neck stiffness and a positive Kernig's sign. He has developed a spotting, non-blanching rash over his anterior chest wall.
He has no focal neurological deficits.

A lumbar puncture has been carried out. What is the likely cerebrospinal fluid analysis result?

A) Raised white cells (90% lymphocytes), raised protein, low glucose

B) Raised white cells (90% neutrophils), low protein, raised glucose

C) Raised white cells (90% neutrophils), raised protein, low glucose

D) Normal white cells, raised protein, normal glucose

References

1. Kumar & Clark's Clinical Medicine 9th Edition
2. Dr. Amreeta Dhanoa's slides - Infections of Central Nervous System (Part 1) 2023
3. https://www.cdc.gov/meningitis/about/bacterial-meningitis.html
4. https://www.uptodate.com/contents/clinical-features-and-diagnosis-of-acute-bacterial-meningitis-in-adults?search=meningitis&source=search_result&selectedTitle=1%7E150&usage_type=default&display_rank=1#H5
5. https://www.uptodate.com/contents/lumbar-puncture-technique-contraindications-and-complications-in-adults#H2162651805
6. https://www.researchgate.net/figure/Typical-Cerebrospinal-Fluid-Findings-in-Various-Types-of-Meningitis_tbl2_9068277
7. https://tgldcdp.tg.org.au/viewTopic?etgAccess=true&guidelinePage=Antibiotic&topicfile=meningitis&guidelinename=Antibiotic&sectionId=toc_d1e861#toc_d1e861
8. Akaishi, T., Kobayashi, J., Abe, M., Ishizawa, K., Nakashima, I., Aoki, M., & Ishii, T. (2019). Sensitivity and specificity of meningeal signs in patients with meningitis. Journal of general and family medicine, 20(5), 193–198. https://doi.org/10.1002/jgf2.268
9. https://www.uptodate.com/contents/evaluation-and-management-of-elevated-intracranial-pressure-in-adults#H8
10. Davidson's Self Assessment in Medicine