BEST PRACTICE RECOMMENDATIONS
FOR CEREBROSPINAL FLUID (CSF) SPECIMENS

SPECIMEN OPTIMAL SAMPLING

COMMONWEALTH PHARMACISTS ASSOCIATION

THET

CwPAMS

CwPAMS is funded by the UK Department of Health and Social Care's Fleming Fund using UK aid. The views expressed in this publication are those of the authors and not necessarily those of the UK Department of Health and Social Care.

Key Points

Meningitis is defined as inflammation of the meninges. This process may be acute or chronic and infective or non-infective. Many infective agents have been shown to cause meningitis, including viruses, bacteria, fungi and parasites. Diagnosis of meningitis is best established by laboratory examination of CSF, obtained by lumbar puncture (LP).

LP is the gold standard diagnostic procedure in the diagnosis of meningitis, subarachnoid hemorrhage, and certain neurological disorders.

Meningitis is described as:

Pyogenic (purulent), when CSF contains mainly polymorphonuclear neutrophils (pus cells), as in acute meningitis caused by *Neisseria meningitidis, Haemophilus influenzae*, and *Streptococcus pneumoniae*. Pus cells are also found in the CSF in acute amoebic meningoencephalitis.

Lymphocytic, when the CSF contains mainly lymphocytes, as in meningitis caused by viruses, *M. tuberculosis*, and *C. neoformans*. Lymphocytes are also found in CSF in trypanosomiasis meningoencephalitis, and neurosyphilis.

Encephalitis is an inflammation of the brain parenchyma, that presents as diffuse and/or local neuropsychological dysfunction.

Risk Groups

Immunosuppressed patients are susceptible to meningitis caused by Listeria monocytogenes, *Cryptococcus neoformans*, *Nocardia* and *Toxoplasma gondii.*

***Cryptococcus* is mostly associated with HIV infection, consider performing an HIV test if status is unknown.**

Patients with intracranial prosthetic material such as CSF shunt are susceptible to infection caused by *Staphylococcus aureus*, coagulase-negative staphylococci, *Corynebacterium* species, *Propionibacterium* species, *Candida* species and Enterobacteriaceae.

The **diagnosis of meningitis** from the examination of CSF includes the following:

- Complete cell count
- Differential leucocyte count
- Microscopy
- Culture
- Determination of glucose and protein concentrations (usually performed by clinical biochemistry departments)
- PCR where appropriate
- Antigen testing

Likely Pathogens

Bacteria	Gram Positives - *Streptococcus pneumoniae,* Lancefield group B Streptococci, *Listeria monocytogenes*
	Gram negatives - *Neisseria meningitidis, Haemophilus influenzae* type b, *Escherichia coli, Pseudomonas aeruginosa, Proteus* species, *Salmonella* serovars.
	Other - *Mycobacterium tuberculosis* and spirochetes i.e. *Treponema pallidum, Borrelia, Leptospira*
	Brain abscess, e.g. *Bacteroides* species, *Streptococcus milleri* and other anaerobes
Viruses	Coxsackieviruses, echovirus, and arboviruses, herpes simplex 2 virus, varicella zoster virus, and lymphocytic chorio-meningitis virus (LCM)
Parasites	*Trypanosoma* species, *Naegleria fowleri*, larvae of *Angiostrongylus cantonensis* and *Dirofilaria immitis* (CSF usually contains eosinophils), *Toxoplasma gondii*
Fungi	*Cryptococcus neoformans, Histoplasma capsulatum* and *Aspergillus* species.

When to Start Treatment

Initiate effective antimicrobial therapy quickly. Treatment should be guided by local treatment guidelines and the most likely cause. The results of microscopy (cell count and Gram stain), may lead to a change in treatment. This should be communicated to the clinical team urgently

Abnormalities associated with bacterial meningitis

- Reduced glucose concentration: <60% blood glucose (CSF: serum ratio <0.6)
- Elevated protein concentration
- Raised white blood cell (WBC) count: 10^{1} - 10^{4} predominantly polymorphs
- Elevated intracranial pressure

Following Gram stain and cell count interpretation, proceed to sub-culture CSF on appropriate media after which you identify the bacterial causative agent and perform antimicrobial susceptibility.

Treatment escalation/de-escalation should be based on microbiology results and/or clinical response.

*Antibiotics are not active against viral Central Nervous System infections.

References: 1. Standards for Microbiology Investigations: Investigation of Cerebrospinal Fluid 2. District Laboratory Practice in Tropical Countries, Part 2; Monica Cheesebrough