Online Quiz

Test Your Knowledge: Ten Questions about Abnormal Cerebrospinal Fluid Results

This quiz is related to the Learning Forum article in the October issue of *PLoS Medicine* (DOI: 10.1371/journal.pmed.0010007).

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**Question 1.** Which of the following is an abnormal cerebrospinal fluid (CSF) finding?
- A glucose level that is less than 50% of the plasma glucose level
- A protein level of less than 0.5 g/l
- A cell concentration of 0–5 cells/µl

**Question 2.** Which of the following CSF results suggests fungal meningitis?
- Elevated CSF neutrophil count, raised protein, and low glucose
- Elevated protein, 20 lymphocytes/µl, and normal glucose
- Moderately elevated CSF lymphocyte count of 200 cells/µl, raised protein, and low glucose

**Question 3.** Which of the following is true about the CSF changes in patients with tuberculous meningitis?
- The cell count is often elevated, and the cells are mainly neutrophils
- In detecting *M. tuberculosis* in the CSF by nucleic acid amplification tests (such as polymerase chain reaction [PCR]), the sensitivity and specificity are close to 100%
- A normal CSF does not exclude cerebral tuberculosis

**Question 4.** Which of the following does not cause the CSF picture of “aseptic” meningitis?
- Bacterial meningitis
- Viral meningitis
- Drug-induced meningitis

**Question 5.** Which of the following is true about CSF analysis in bacterial meningitis?
- A raised CSF lactate suggests tuberculous disease
- Common bacterial pathogens may be identified by rapid polysaccharide antigen detection
- Antibiotic therapy should be delayed until after a lumbar puncture to ensure that bacterial cultures are positive

**Question 6.** Which of the following is most likely to cause a low CSF glucose?
- Sarcoidosis
- Enteroviral meningitis
- Drug-induced meningitis

**Question 7.** Which of the following is true about Mollaret’s meningitis?
- It is rarely recurrent
- It has been associated with herpes simplex virus
- It is characterized by the appearance of large lymphocytes in the CSF

**Question 8.** The CSF in Lyme meningitis typically shows which of the following?
- A low-grade lymphocytic pleocytosis, reduced glucose, and elevated protein
- A neutrophil leucocytosis with a normal glucose and protein
- A neutrophil leucocytosis, reduced glucose, and elevated protein

**Question 9.** In the United Kingdom, which of the following is the most common cause of viral meningitis in immunocompetent adults?
- Mumps
- *Herpes zoster*
- Enteral viruses

**Question 10.** The CSF in West Nile encephalitis typically shows which of the following?
- A moderate lymphocytic pleocytosis, moderately increased protein, and a normal CSF: plasma glucose ratio
- A normal cell count, highly elevated protein, and a reduced CSF: plasma glucose ratio
- No abnormalities


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Answer 1. A glucose level that is less than 50% of the plasma glucose level
Normal CSF findings are a glucose level greater than 50% of the plasma glucose level, a protein level of less than 0.5 g/l, and 0–5 cells/µl (usually monocytes).

Answer 2. Moderately elevated CSF lymphocyte count of 200 cells/µl, raised protein, and low glucose
In fungal meningitis, the CSF most commonly shows a moderately elevated lymphocyte count [1]. Classically, the glucose is low and protein elevated. Not all patients with fungal meningitis have marked CSF changes—for example, the cellular changes may be minimal in patients with advanced AIDS and cryptococcal meningitis.

References

Answer 3. A normal CSF does not exclude cerebral tuberculosis
Classical CSF changes in tuberculous meningitis are the following: markedly elevated CSF protein, raised lymphocyte count, and a low glucose. A small proportion of cases may present with neutrophils in the CSF or a mixed picture with both neutrophils and lymphocytes.

A systematic review and meta-analysis of nucleic acid amplification tests for tuberculous meningitis found that these tests have a sensitivity of 56% (95% CI 46%–66%) and a specificity of 98% (95% CI 97%–99%) [1]. The CSF may be normal or have only minor changes in cerebral abscesses due to tuberculosis (tuberculomas).

References

Answer 4. Bacterial meningitis
Aseptic meningitis is usually taken to mean a CSF picture dominated by lymphocytes or mononuclear cells with no organisms seen on microscopy [1,2]. Viral meningitis is the most common cause. Tuberculous meningitis must be considered in all cases, as well as other atypical infections such as Lyme disease or brucellosis. Non-infectious causes include drug-induced meningitis, Vogt-Koyanagi-Harada syndrome, connective tissue diseases, and sarcoidosis.

References

Answer 5. Common bacterial pathogens may be identified by rapid polysaccharide antigen detection
The causative organism in bacterial meningitis may be rapidly diagnosed by CSF detection of bacterial antigens for Haemophilus influenzae, pneumococcus, and meningococcus [1]. This can be particularly useful if recent antibiotic therapy has led to the CSF culture being negative. PCR detection of bacterial DNA is more sensitive, and PCR is becoming more widespread, but in most laboratories it cannot be deployed in “real time.” CSF lactate is raised in bacterial meningitis, and this fact has been used to aid diagnosis in some settings [2]. Early antibiotic administration is essential in bacterial meningitis and should not be deferred if there is to be a significant delay in performing a lumbar puncture [3].

References

Answer 6. Sarcoidosis
Neurosarcoid produces an abnormal CSF in at least 80% of cases. Typical changes include a raised protein and an increased density of cells, which are predominantly monocytes. Low CSF glucose may occur with neurosarcoid, making distinction from tuberculosis difficult [1].

References

Answer 7. It has been associated with herpes simplex virus
Mollaret’s meningitis is a recurrent aseptic meningitis that has been associated with herpes simplex virus [1] and that is characterized by the appearance of large monocytes in the CSF [2]. The diagnosis is generally established by PCR detection of herpes simplex virus DNA within the CSF.

References

Answer 8. A low-grade lymphocytic pleocytosis, reduced glucose, and elevated protein
The CSF in Lyme meningitis, caused by Borrelia burgdorferi, is characterized by a low-grade lymphocytic pleocytosis, reduced glucose, and elevated protein [1]. The diagnosis may be confirmed by the detection of specific Lyme disease immunoglobulins within the CSF or by CSF PCR.

References

Answer 9. Enteroviruses
In the UK, enteroviruses are the most common cause of viral meningitis in immunocompetent adults. CSF changes in viral meningitis are relatively nonspecific, with an elevated lymphocyte count and protein level and a normal CSF glucose. PCR is now the diagnostic modality of choice for central nervous system viral infections but is not available in “real time” within most centers.

Answer 10. A moderate lymphocytic pleocytosis, moderately increased protein, and a normal CSF: plasma glucose ratio
Examination of the CSF in West Nile encephalitis typically shows a moderate lymphocytic pleocytosis, though sometimes there may be no cells, or neutrophils may predominate. Protein concentrations are moderately increased, and the glucose ratio is typically normal [1].

References
References