



Puncturing Through the Mystery of CSF Analysis

Ori D. Scislowicz, BS, LVT

A common diagnostic test recommended for patients referred to Neurology is a CSF analysis. CSF stands for cerebrospinal fluid, the fluid that bathes the spinal column and the brain. A white blood cell count is useful to detect inflammation in the body outside of the blood – brain barrier, whereas a CSF tap is done by puncturing the meninges (lining of the brain and spinal cord) and crossing the blood brain barrier. The fluid analysis determines first if there is inflammation within the meninges and brain (meningoencephalitis) and also provides insight as to whether the inflammation is from an infectious, non-infectious or neoplastic cause. Fluid is collected while patients are under general anesthesia and this diagnostic is often performed following a MRI.

CSF must be collected with aseptic technique to ensure that no bacteria are introduced into the nervous system and the fluid collected is not contaminated. To accomplish this, the site of puncture is clipped and prepped and sterile gloves and needles are used to perform the test.

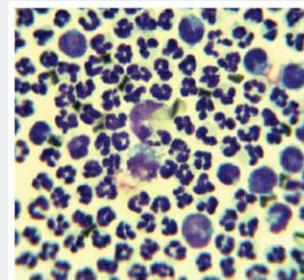
Some of the results that may be found include:

- Mixed pleocytosis (no predominating single cell type)
- Lymphocytic pleocytosis (elevated total nucleated cell count (TNCC), and >50% lymphocytes)
- Neutrophilic pleocytosis (elevated TNCC, and predominance of neutrophils)
- Eosinophilic pleocytosis (elevated TNCC, and >10-20% eosinophils)

These findings can assist the neurologist in developing disease differentials. Mixed pleocytosis can suggest differentials such as GME (Granulomatous meningoencephalitis), neoplasia or infection. Lymphocytic pleocytosis can be indicative of lymphoma, immune disease or infections (protozoal, viral, fungal, others). In cases of



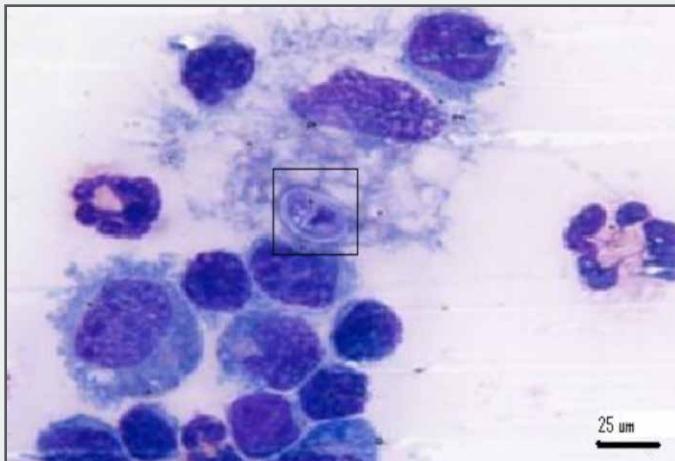
SRMA (steroid responsive meningitis-arteritis), FIP and neoplasia, cerebrospinal fluid can exhibit neutrophilic pleocytosis. Lastly, in the eosinophilic pleocytosis category there is more of a likelihood of EME (eosinophilic meningoencephalomyelitis), cryptococcosis and parasitic migration.



This is a CSF cytopspin prepared slide at 40x of a patient with SRMA. A normal slide would have only a few cells. This is teeming with inflammatory cells that are predominantly neutrophils.

Based on the MRI findings, as well as the patient's exam, the CSF can be the final piece in the puzzle to narrow down the suspected disease process. Even the nucleated cell count can help point towards certain diagnoses. For example, a lower cell count can be indicative of a vascular event or neoplasia, while a cell count of >50 cells/uL could be indicative of inflammatory disease.

Similar to a differential white blood cell count, infectious agents can appear occasionally on a cerebrospinal fluid differential. Bacteria, protozoa and fungal elements can sometimes be seen. Distemper inclusion bodies as well as Ehrlichia morulae can also appear in CSF fluid. Pictured below is a CSF analysis done in which Dr. Young discovered *Prototheca* in the CSF of a 3 year-old Spaniel mix. *Prototheca zopfii* organism is noted in the box along with a mixed pleocytosis.



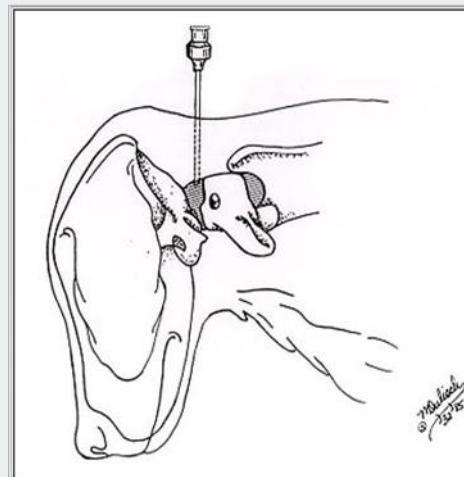
Young M, Bush W, et al. Serial MRI and CSF analysis in a dog treated with intrathecal amphotericin B for protothecosis. *J Am Anim Hosp Assoc*. 2012 Mar-Apr;48(2):125-31. doi: 10.5326/JAAHA-MS-5701. Epub 2012 Jan 19.

Numerous tests can be performed on CSF fluid. Infectious disease testing looks for antibodies to an infectious agent such as Toxoplasma or Neospora. PCR can be tested to detect genetic material from the actual organism like distemper virus. In very cellular CSF analysis, PCR testing can be done to test for lymphoma. CSF can also be sampled on a research basis to determine how much of a drug given by mouth or intravenously actually crosses the blood brain barrier.

While CSF analysis can be very useful, there are situations where it is contraindicated to obtain a cerebrospinal fluid sample. Flexing a patient with atlanto-axial instability for a cisternal tap can be life-threatening. Very low platelet counts or severe increases in intracranial pressure can place a patient at increased risk for the procedure.

There are two options for collection sites- the lumbar space or cisterna magna (the atlanto-occipital space). For a lumbar puncture, the patient is in lateral recumbency with the dorsum parallel to the table and pelvic limbs are flexed. In a cisternal tap, a technician manipulates the head into ventral flexion with the nose parallel to the table. The neurologist uses a spinal needle to puncture the space, removes the stylet and advances slowly looking for flow of CSF. It is vital in both locations for the assisting technician to keep the animal completely still as the neurologist is puncturing very close to the spinal cord. Prior to positioning, the technician should be sure that the patient is on an adequate plane of anesthesia.

The most common collection site BVNS uses is the Cisterna Magna. Pictured below is the anatomical model of needle placement.



Site of cisternal puncture for spinal fluid collection and/or insertion of contrast medium for myelography. (From Morgan RV. Selected diagnostic and therapeutic procedures. P. 17. In Morgan RV (ed): *Handbook of Small Animal Practice*. 3rd Ed. WB Saunders, Philadelphia, 1997, with permission.)

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