How to do a CSF tap?

Definition: CSF is an ultrafiltrate of plasma that is produced predominantly by the choroids plexi within the ventricular system. CSF flows caudally through the ventricular system to the central canal of the spinal cord toward the cauda equina.

Indications

Neurological signs that are referable to the CNS.

Cerebrospinal fluid collection is helpful in evaluating any organic brain or spinal cord disease. It helps to differentiate inflammatory, immune-mediated, degenerative, haemorrhagic, and neoplastic forms of parenchymal disease. It is considered when there is a recent history of central nervous system (CNS) signs, and when neurologic deficits are discovered upon physical examination. It is frequently performed after advanced imaging (computed tomography, magnetic resonance imaging) techniques demonstrate abnormalities in the CNS.

Cerebrospinal taps are also performed as a component of contrast myelography.

NB: CNS disease does not consistently cause alterations in CSF; abnormalities depend on the location and extent of the CNS lesion. Parenchymal, extradural and non exfoliative lesions may cause minimal (protein elevation) or no change in the CSF.

Preparation:

General anaesthesia is required for this procedure.

A spinal needle with a stylet is used for the spinal tap. In small dogs and cats, a 22-gauge, 1"- 2" needle is used. In large dogs, a 20-gauge, 1"-3" needle is used. The CSF is allowed to drip directly into the collection tube (EDTA and plain).

Positioning:

1. **Cisternal tap** - The animal is placed in lateral recumbency, with the head flexed ventrally to almost 90-degrees so that the atlanto-occipital space is opened. The ears are pulled forward to tense the skin on the back of the neck. The nose is held parallel to the table. A sandbag may be used under the head to keep the spine at a consistent distance from
the surface of the table. A large rectangle should be clipped including the occipital protuberance the base of the ears and up to C 3 caudally and prepped surgically.

2. *Lumbar tap* - The animal is placed in lateral recumbency with the hind legs pulled in a cranial direction. This opens the interarcual space between the lumbar vertebrae. The animal must be immobilized with the entire spine in a straight position. A large rectangle over the lumbar spine should be clipped and prepped surgically.

**Technique:**

For the *occipital tap*:

1. The external occipital protuberance and the rostral wings of the atlas are palpated. Using the index finger, the depression between these three structures is located. The needle will be inserted at this depression.

2. The spinal needle with stylet in place is inserted through the skin, subcutis and muscles of the neck. Both the dura mater and arachnoid membranes are penetrated with the needle. A slight popping sensation may be detected when the needle enters the subarachnoid space.

3. The stylet is withdrawn with the advancement of the needle through the membranes so that the presence of fluid can be detected. If no fluid is seen, the stylet is replaced before the needle is advanced further.

4. The fluid is collected by allowing the fluid to drip into the collection tube.

5. The needle is then smoothly withdrawn and a swab is applied for 1 min.
Procedure for the Lumbar Tap

1. The dorsal spinous processes of the lumbar vertebrae are located, with attention focused on the L4-5 and L5-6 intervertebral spaces.

2. The spinal needle is inserted through the skin, subcutis and musculature over the spine and into the space immediately cranial to the dorsal spinous process of the lumbar vertebra.

Sample handling:

CSF is submitted for analysis, cytology (EDTA tube) and microbiologic culturing (plain tube) and some serologies (i.e Distemper, Toxoplasma, Neospora in dogs and Toxoplasma in cats). Analysis of CSF requires the use of a cytopsin centrifuge because the cellular component is very small. Processing of the sample must also be done quickly (within 20 to 60 minutes), as the CSF contains very little protein, cells degrade when allowed to sit over night or during mailing. The sample may be fixed using 2 drops of 10% buffered formalin per mL of CSF if the sample can not be delivered immediately to the lab. However not every lab is equipped for cytological evaluation of fixed CSF. Another technique to retard cellular degeneration is the addition of 20% albumin (2 drops). Protein and enzyme concentrations are relatively stable and submission using routine methods is usually sufficient for accurate determinations. Normal CSF is completely clear and colourless. The sample may appear turbid with infection or marked inflammation and white blood cell (WBC) counts > 500/ml. The colour may be pink to red with red blood cell (RBC) counts > 6000/ml, and this is most often secondary to recent haemorrhage or haemorrhagic conditions. A yellow colour (xanthochromia) may be imparted to the fluid from episodes of prior haemorrhage.

Normal WBC counts are < 8 from the cisterna magna and < 12 from the lumbar cisterna. All normal cells are mononuclear in cell type.
Red blood cell counts - Normal CSF contains no red blood cells. With iatrogenic haemorrhage, one WBC is expected for every 500 RBCs. RBC counts higher than this indicate pathologic haemorrhaging. The presence of crenated RBCs or erythrophagocytosis is evidence of prior haemorrhage.

Protein levels - In normal CSF protein levels are usually < 25 mg/dl in the dog and < 20 mg/dl in the cat when collected from the cisterna magna, and < 40 mg/dl when collected from the lumbar cistern.

- Protein is elevated in any condition that causes breakdown of the blood-brain barrier (e.g. inflammation, infection) or necrosis within the CNS (e.g. neoplasia).
- Elevated CSF protein without concurrent elevations in cell counts may be seen with feline polioencephalomyelitis, feline ischemic encephalopathy, canine degenerative myelopathy, and certain brain and spinal cord tumours.
- With iatrogenic haemorrhage, it is important to note that the presence of 1000 RBCs will increase the CSF protein level by 1 mg/dl.

Antibody titers - Titers to certain infectious diseases may be measured in CSF. Examples include canine distemper, toxoplasmosis and neosporosis.

Culture and sensitivity testing - These tests are indicated with any CSF sample that has an elevated cell count, particularly if neutrophils predominate. Culturing may be attempted for aerobic bacteria, anaerobic bacteria (and fungi). A high number of false-negative results occur with both bacterial and fungal infections of the CNS.

**Complications:**

CSF collection requires a general anaesthesia and is associated with uncommon but serious risks:

1. Haemorrhage
2. Cerebellar herniation (signs: nystagmus, change in papillary size, changes in respiration pattern and reflex abnormalities.
3. Respiratory arrest
4. Spinal cord puncture

NB: CSF analysis should be performed prior to inject radioopaque contrast medium for a myelography as these can lead to exacerbation of the clinical signs when meningitis is present.
Suggested readings:

BSAVA Manual of Canine and Feline Neurology
BSAVA Manual of Canine and Feline Clinical Pathology