

Central nervous system diagnostics

Dusty W. Nagy, DVM, PhD, DACVIM – LA
Texas A&M University, College Station, TX 77843

Abstract

Both antemortem and postmortem diagnostics for central nervous system disease are available. Cerebrospinal fluid will help determine if disease is bacterial, viral, parasitic, or degenerative in nature. In addition, it may help to rule out diseases outside the central nervous system like hypocalcemia, which may mimic disease within the CNS. In addition to CSF analysis, diagnostic imaging can also be helpful. Animal size and value will often dictate the utility and affordability of imaging modalities. Postmortem, we typically consider harvesting the brain for histopathology, culture, or specific assays or special staining.

Key words: bovine, CNS, nervous system, diagnostics

Résumé

Le diagnostic ante- et post-mortem est une option pour les maladies du système nerveux central (SNC). Le liquide céphalorachidien va aider à déterminer si la maladie est d'origine bactérienne, virale, parasitaire ou dégénérative. De plus, il peut aider à écarter des maladies hors du SNC, telle l'hypocalcémie, qui peuvent ressembler à des maladies du SNC. En plus de l'analyse du SNC, le diagnostic par imagerie peut aussi être utile. La taille de l'animal et sa valeur vont souvent déterminer l'utilité et l'abordabilité des modalités d'imagerie. En post-mortem, nous considérons typiquement le prélèvement du cerveau pour l'histopathologie, la culture, des essais spécifiques ou des colorations spéciales.

Cerebrospinal Fluid

Collection

Cerebrospinal fluid can be collected from either the atlanto-occipital space (AO) or the lumbosacral space (LS), with the latter being more common. The AO tap is not technically more difficult, but has more potential for complications. As such it requires heavy sedation, anesthesia, or significant manual restraint to hold the head in the appropriate position. Surgical prep and sterile gloves are necessary for either location.

| | Atlanto-occipital | Lumbosacral |
|------------------|---------------------------------|--------------------------------|
| Cranial landmark | External occipital protuberance | Dorsal spine L6 |
| Caudal landmark | | S1 – not palpable, S2 palpable |
| Lateral landmark | Cranial edge atlas wings | Tuber sacrale |
| Position | Head in flexion | Standing square |
| Angle of drive | Toward lower jaw | Perpendicular |
| Needle gauge | 18, 20 | 18, 20 |
| Needle length | 3.5 inch | 3.5 - 5 inch |

Analysis

It is useful to determine the etiology of the disease process during the diagnostic workup. This will help narrow the list of possible differential diagnoses and provide some direction in the ultimate therapeutics of the case. The most useful test for providing this information for neurologic conditions is cerebrospinal fluid analysis. Changes in cerebrospinal fluid protein concentration and cell count will help determine the broad category of disease as well as remove diseases outside the CNS that may mimic CNS disease.

Anticipated Cerebrospinal Fluid Analysis Results by Disease Status

| Disease | Protein g/L | Cells/ μ L | Cells-type |
|--------------|-------------|----------------|--------------------------|
| Normal | <0.4 | <10 | lymphocytes |
| Viral | 0.40-1.0 | 50-200 | monocytes lymphocytes |
| Bacterial | >1.0 | >200 | neutrophils |
| Degenerative | <0.4 | <10 | monocytes |

Additional Changes

- Turbidity – occurs with increased cell count. Do not need turbidity to be abnormal.
- Red tinge – indicates presence of blood.
- Xanthochromia (yellowing) – may become evident within 6 hours of CNS bleeding. Typically present up to 10 days post bleeding event.

Removal of the Brain

The brain can be removed from the calvarium with the use of an axe.

- Cut 1 – just dorsal to the lateral canthus across the face
- Cut 2 – from the lateral canthus toward the ear
- Cut 3 – across the poll to the opposite ear.

Once you have made the cuts, use the blunt side of the axe and strike the cut bone between the lateral canthus of the eye and the poll at a 45° angle to remove the calvarium.

Cut through the dura and remove the brain. This is easiest to accomplish in 2 pieces. Lift the cerebrum and cut between the cerebrum and cerebellum at the level of the pons. This will allow removal of the cerebrum. Then slide the necropsy knife into the spinal canal and transect the cord distal to the obex.

Alternatively, the head can be disarticulated at the atlanto-occipital joint. This is found by flexing and extending the head to locate the level of the joint. Cut through the soft tissues ventrally to locate the ventral spinal canal. Transect the spinal cord through the space and disarticulate the joint

by sliding the knife between the wings of the atlas and the occipital condyles. Cut through the remaining soft tissues of the neck. Cuts through the calvarium should be made medial to each occipital condyle and carry rostrally to the supraorbital processes. These should then be connected. The blunt end of the axe can be used to strike the calvarium at the poll to remove the bone. Cut the dura and spinal nerves to remove the brain.

The obex is the widened triangular shaped structure just caudal to the cerebellum.

<http://video.vet.cornell.edu/virtualvet/bovine/15.html>

Suggested Reading

1. Griffin D. Field necropsy of cattle and diagnostic sample submission. *Vet Clin North Am Food Anim Pract* 2012; 28:391-405.
2. Nagy DW. Diagnostics and ancillary tests of neurologic dysfunction in the ruminant. *Vet Clin North Am Food Anim Pract* 2017; 33:9-18.
3. USDA APHIS. *Procedures manual: Bovine spongiform encephalopathy (BSE) ongoing surveillance program*. October 2008.