LOCALIZATION OF BRAIN LESIONS IN CATS AND DOGS
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The cerebral cortex coordinates voluntary movements and reactions. Clinical signs of cerebral cortex dysfunction include changes in behavior (lethargy, loss of trained habits, irritable, aggressive) or mental status (obtundation, semicoma, coma), and visual and postural reaction deficits. Behavioral changes usually result from a lesion of the limbic system or frontal lobe of the cerebral cortex. Since the frontal lobe has an inhibitory effect on some motor functions, a lesion here removes this inhibition and as a result the animal may continually pace. When an animal reaches a barrier pacing may be replaced with head pressing. Some animals circle, usually to the side of the lesion. Seizures may be partial or generalized.

Conscious visual perception requires intact visual pathways to the occipital lobes of the cerebral cortex. Unilateral lesions of the occipital cortex result in visual deficits in the contralateral temporal visual field, with intact pupillary light reflexes. Bilateral lesions produce blindness.

Although the motor cortex is important for voluntary motor activity, it is not necessary for relatively normal gait and posture. Animals with lesions here may be able to stand, walk and run with minimal deficits, but control of finer movements is lost and they may have difficulty avoiding obstacles and contralateral postural reactions are usually deficient.

Clinical Signs of Cerebral Dysfunction

1. Altered mental status
   a. Obtundation
   b. Semicoma
   c. Coma
2. Change in behavior
   a. Loss of trained habits
   b. Failure to recognize owner
   c. Aggression
   d. Hyperexcitability
3. Abnormal movement and/or posture
   a. Pacing, wandering, circling
   b. Head pressing
   c. Twisted head or trunk
4. Postural reaction deficits in contralateral limbs
5. Visual impairment
   a. Contralateral menace deficit
   b. Normal pupillary light reflexes
6. Seizures
7. Papilledema (rarely)
8. Irregular respiration (rarely)

Although it is possible to localize a problem to the brain and sometimes to the approximate location within the brain, it must be remembered that clinical signs may be the same regardless of the underlying cause. Brain tumors, infections, congenital disorders, trauma, vascular disorders, degeneration, immunologic and metabolic disorders, toxicities, and idiopathic disorders may result in similar clinical signs. For this reason it is essential to follow a logical diagnostic plan for a cat or dog with signs of brain dysfunction.

Some Common Disorders Affecting the Cerebrum of Dogs and Cats

1. Degenerative -
   a. Lysosomal storage diseases:  
      Fucosidosis - Springer spaniel  
      Gangliosidosis - cats, dogs  
      Ceroid lipofuscinosis - dogs

2. Anomalous/Developmental -
   a. Hydrocephalus
   b. Lissencephaly - small smooth brain with absent gyri and abnormal arrangement of cells in cerebral cortex
   c. Hydranencephaly - virtual absence of cerebral hemispheres and basal nuclei, with remnants of mesencephalic structures
   d. Porencephaly - a circumscribed cerebral defect that communicates with the ventricular system
   e. Meningoencephalocele - herniation of part of the brain and meninges through a defect in the skull

3. Metabolic
   a. Hepatic encephalopathy
   b. Miscellaneous
      Hypoglycemia

4. Neoplastic
   a. Primary brain tumor
   b. Secondary brain tumor
      Local extensions from skull, middle ear, pituitary, nasal cavity
      Metastasis

5. Inflammatory/Infectious
   a. Viral
      Canine distemper
      Old dog encephalitis
      Feline infectious peritonitis
      Parvovirus encephalitis
   b. Unknown cause
      Granulomatous meningoencephalomyelitis
Eosinophilic meningoencephalitis

c. Protozoal
   Toxoplasmosis
   Neosporosis

d. Mycotic
   Cryptococcus neoformans
   Others - Blastomyces dermititidis, Histoplasma capsulatum,
   Coccidioides immitis, Cladosporium trichoides,
   paecilomyces, Aspergillus spp., etc

e. Bacterial
   Abscessation
   Sub-dural empyema

f. Miscellaneous
   Verminous encephalitis
   Foreign body migration

6. Traumatic
7. Vascular
   a. Hemorrhage
   b. Infarction
      Feline ischemic encephalopathy

Following a complete history and physical and neurologic examination, a minimum data base for an animal with signs of brain dysfunction should be obtained. This should include a hemogram, serum chemistry panel, and urinalysis. Survey thoracic radiographs and abdominal ultrasound help to rule out problems elsewhere. The major objective in doing these tests is to exclude disease outside the brain as a cause of the signs of cerebral dysfunction.

Plain skull radiographs are useful for detecting problems of the skull or nasal cavity that may have extended to the brain. Occasionally, lysis or hyperostosis of the skull may accompany a primary brain tumor (e.g., meningioma of cats) or there may be mineralization of a neoplasm. Skull radiographs are of little value in detecting dysfunction within the brain.

Cerebrospinal Fluid

Analysis of cerebrospinal fluid (CSF) is recommended as an aid in the diagnosis of a brain disorders. The results of CSF analysis may help to identify inflammatory causes of cerebral dysfunction, and in some cases may support diagnosis of a brain tumor. CSF bathes the entire CNS, both internally (the ventricles and central canal) and externally (the subarachnoid space). CSF composition may be affected by many nervous system diseases and the ease with which this fluid may be collected has made it a useful diagnostic tool in the diagnosis of CNS disease. Unfortunately, for cells to be shed into the CSF a disease must involve the ventricular system or the subarachnoid space.
Disorders involving deeper brain structures (e.g. neoplasms) may not shed cells into the CSF. Frequently these diseases disrupt the blood-brain barrier allowing protein to leak into the CSF and resulting in an increased protein level. CSF must be evaluated keeping in mind history and clinical signs. Neoplasms and some other non-inflammatory diseases may result in inflammatory changes in CSF composition. CSF composition may also change as a disease becomes more chronic. Also, following various therapies CSF may no longer accurately reflect an etiology.

Care should be used in the collection of CSF, because frequently an increased intracranial pressure (ICP) may be present in association with a brain tumor, and pressure alterations associated with CSF removal may cause brain herniation. Because CSF pressure measurements are of limited usefulness, it is often desirable to utilize techniques such as hyperventilation to decrease intracranial pressure prior to CSF collection.

CSF may be collected at either the cerebellomedullary cistern or by lumbar puncture. In general the cerebellomedullary cistern is easier to perform, allows collection of a larger volume and generally collection from this area results in less blood contamination. All patients undergoing CSF collection should be anesthetized appropriately. If it is suspected that intracranial pressure is elevated the patient should be hyperventilated for several minutes prior to collection as well as during and after collection in order to decrease arterial CO₂ and intracranial pressure. Complications of CSF collection include needle injury to the brain and herniation of the brain, usually due to high intracranial pressure. Both these complication may be fatal if appropriate steps to reduce intracranial pressure (hyperventilation and mannitol administration) are not instituted immediately.

CT and MRI

CT and MRI allow imaging of brain tissue rather than just the surrounding bony skull. Both can distinguish lesions which have only slightly different densities than the surrounding tissues and this can be further enhanced by contrast agents allowing the identification of masses and other abnormal tissues within the brain. Images obtained by means of MRI may be superior to those of CT especially in certain areas such as the brain stem, although CT is usually better for bony lesions (e.g. middle ear studies). While the major tumor types are reported to have characteristic CT or MRI appearances, non neoplastic lesions may mimic the CT or MRI appearance of a neoplasm, and occasionally a metastasis may resemble a primary brain tumor on CT or MRI images. Patients for either CT or MRI must be anesthetized, intubated, and hyperventilated whenever an increase in ICP is even suspected. Proper patient positioning is extremely important. The animals should be placed in sternal recumbency with the head extended. The entire calvaria should be examined in the non contrast series of images. This should be followed by a post contrast series of images.
Patient signalment, history and physical and neurological examination findings will help to localize a lesion to the brain and possibly a particular area of the brain. Further diagnostic tests are required to localize the affected area within the brain, and to obtain an accurate diagnosis. These tests include CSF analysis, CT or MR imaging, and brain biopsy.

References

