Practical Differential Diagnosis of Polioencephalomalacia and Thromboembolic Meningoencephalitis

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Neurological diseases of cattle have become very important to veterinarians in the past five years. As stockmen's management practices have improved, their demands for more sophisticated diagnostic and therapeutic techniques from veterinarians have increased. The veterinarian who successfully meets these legitimate demands gains, and deserves, the respect and business of the livestock industry.

Accurate diagnosis of polioencephalomalacia (polio) and thromboembolic meningoencephalitis (thrombo) is possible on a practical clinical basis. All that is required is a thorough clinical examination and a simple analysis of cerebrospinal fluid (CSF). Because the approach to therapy is different in the two diseases, accurate diagnosis is an absolute necessity.

Observation of unrestrained animals is helpful if the patient is ambulatory. Due to the polio victim's characteristic blindness, which makes it unaware of its surroundings, the animal tends to walk into objects. The polio victim may walk with the head raised and "step high" with the forefeet.

Thrombo victims may also be blind. Early cases may be ataxic or knuckle over on their hind pasterns. These signs are by no means pathognomonic for thrombo, but once the disease is diagnosed in a herd, they are useful aids in identifying new cases. Usually the animals have the presence of mind to avoid climbing into mangers and feed bunks, and they do not become trapped in corners. Nystagmus, circling, and aimless wandering may accompany either disease. Temperatures and blood counts are not reliable diagnostic aids. Both diseases may occur in the same herd.

Animals that are down from either disease may be similar in appearance; therefore, cranial nerve function evaluation becomes necessary for differentiation. Evaluation of sight and eye fixation and movement are easy to perform and helpful in determining the location and to a degree the type of brain lesions. The blink reflex is adequate for evaluating sight. With the animal's head in a normal position, notice positioning of eyes and upper eyelids. Rotate the head and observe the relative movement of both eyes. Raise and lower the chin and observe rotation of the eyes. Normally the eyes will rotate while maintaining the pupil in a horizontal plane. If positioning of the eyes at rest is markedly asymmetrical, it indicates focal midbrain damage. An unequal degree of rotation of the eyeball in response to movement of the head is also likely to be associated with focal midbrain damage.

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Thrombo characteristically has multiple lesions throughout the brain which are clinically recognizable by functional disturbances of individual cranial nerves. When a thrombo lesion involves the nucleus or tract of a cranial nerve, it usually makes it nonfunctional. By recognizing paralyzed cranial nerves and knowing their origins and tracts, one can predict the probable locations of lesions. As a rule, thrombo causes unilateral or asymmetrical bilateral cranial nerve involvement. Frequently the victims are blind from severe pupillary constriction. Atropine ophthalmic preparations will dilate the pupil and restore sight.

The predominant pathology of polio is liquifactive necrosis of the cerebral cortex. Polio may be manifested by symmetrical cranial nerve functional distrurbances, especially of the fourth nerve. These changes appear to be due to causes other than brainstem lesions for this part of the brain typically escapes involvement. Increased intracranial pressure may cause both eyes to rotate dorsally, with the anterior end of the pupil rotated upward and backward while the posterior end of the pupil rotates anteriorly. In most cases the pupil will be constricted. The eyes are fixed in this position and do not move when the head is rotated. When CSF pressure is reduced, the eyes may return to normal position. Similar eye displacement has been seen in a few thrombo cases.

The 5th and 7th cranial nerves can be evaluated by touching the eyelashes, causing the eye to blink. If a blink does not occur, one or both nerves may be affected. A pin prick to the cheek may elicit a pain response by the sensory 5th nerve. If the 7th nerve is involved, paralysis of facial muscles may occur. Other manifestations of 7th nerve dysfunction are excessive or diminished lacrimation. The 5th and 7th nerves are commonly involved by bacterial encephalitis, including thrombo.

Frequently the severity of illness is so great that clinical examination is confusing. In these cases, or whenever a definitive diagnosis is needed, evaluation of cerebrospinal fluid is beneficial. The cisterna magna tap with the animal in lateral recumbency involves some degree of risk but is easy to do under most conditions. Immobilization of the patient and sterile technique are requisites. Following is the technique used in the veterinary clinic at Iowa State University:

1. Securely restrain the patient on its side with both front feet and one hind foot tied together and with the head pulled down toward them and secured with a halter or nose lead.

2. Clip, scrub, and thoroughly disinfect the top of the head and anterior neck. Infiltrate the area with a local anesthetic agent.

3. Employ sterile instruments. Clamp the upper ear to the cheek or halter strap with a towel clamp. Drape the area to keep it clean and to provide a sterile surface on which to lay instruments.

4. Insert a 4–5 inch 18-gauge spinal needle at a point on the midline just behind the ears, 3–4 inches posterior from the poll. Direct the needle well forward until bone is encountered. Retract the needle and direct the tip to a point on the skull ½ inch posterior to the previous insertion. Repeat this process until the needle can be inserted deeper than previously. Progress slowly with the needle under full control so that sudden movements by the animal will not result in misdirected thrusts.

5. Entrance into the cisterna magna may be recognized by a sudden release of pressure or a sudden jerk by the animal. Frequently the only method of knowing that the needle is in the spinal canal is by removing the stylet to see if fluid will flow. Fluid flow may be facilitated by slightly retracting the needle.

6. Observe pressure on a Harvard Spinal Fluid Pressure Manometer. Observe pressure response to jugular occlusion and release.

7. With a sterile syringe remove 5 cc. cerebrospinal fluid for analysis.

Normal pressure with the animal restrained on its side is 150–280 mm. water. Increased pressure up to 600 mm. of water or more may be expected with any of the encephalitides and polio-encephalomalacia.

The jugular vein must be free from oc-

clusion or abnormally high values will be observed.

Inapparent or slow pressure response to jugular occlusion is usually an indication of needle misplacement or obstruction. A rise to 450 mm. water within 20 seconds may normally be seen, and a decline to below initial pressure occurs within 5 seconds of release of jugular occlusion.

A second approach to the cerebrospinal fluid tap is through the dorsal foramen of the lumbar spinal canal. For most clinicians this approach is more difficult, but far safer. Following is the technique used at the Iowa State University Veterinary Clinic:

1. With the animal lying on its side or standing, clip, thoroughly clean, and disinfect the general operating area over the back. Infiltrate puncture area with local anesthetic.

2. Employ sterile technique. Drape the area to control contamination and to provide a sterile working surface on which to lay instruments.

3. Insert a 4–5 inch 18-gauge spinal needle lateral to the anterior end of the spinous process of the third or fourth lumbar vertebrae. Direct the needle perpendicular and slightly medial to the line of the spinal cord (see figure 2). Move slowly and control the needle so that sudden movements by the animal do not result in injury to the animal.

4. Entrance into the subdural space may be recognized by a sudden release of resistance to the needle. The animal may jerk quickly as the needle touches the cord. The dura mater can occasionally be identified as a brief, high resistance to needle movement followed by a rapid loss of resistance as the needle penetrates the membrance.

5. Remove the stylet. If fluid does not flow, slowly retract the needle. It may have been embedded in the spinal cord.

6. Record pressure on a Harvard spinal fluid Pressure Manometer. Press on both jugular veins simultaneously and observe rate and amount of pressure change in the cerebrospinal fluid. Release the jugular occlusion and observe rate of return to normal.

7. With sterile syringe, remove 5 cc. of cerebrospinal fluid for analysis.

The normal cerebrospinal fluid pressure with the animal on its side is 150–280 mm. water. Normal pressure on the standing animal is 80 to 150 mm. water. Increased pressure may accompany any of the common encephalitides. Thrombo and polio frequently have pressures in excess of 600 mm. water. By applying jugular occlusion, observe absence of a rise or presence of a slow rise and fall, indicating either a space-occupying lesion in the spinal canal anterior to the needle site (*i.e.*, an abscess), or an incorrectly placed or obstructed needle. Normal rise is 100–200 mm. water within 20 seconds.

Cerebrospinal fluid pressure readings are important for separating polio from other non-inflammatory changes in the central nervous system. A manometer is also useful to indicate the proper amount of CSF to remove in treatment. The Harvard Spinal Manometer set is available from American Hospital Supply, 2020 Ridge Avenue, Evanston, Illinois. It costs $13.50; the catalogue number is 22092.

ANALYSIS OF CEREBROSPINAL FLUID (CSF)

Analysis of cerebrospinal fluid is necessary for accurate differential diagnosis of polio and thrombo. A practitioner equipped for routine blood studies needs only some diluting fluid and concentrated phenol solution to conduct the necessary evaluations.

Turbidity: Clarity of CSF is not diagnostically significant. Cloudiness and color in CSF are indicative of degenerative central nervous diseases but cannot be used as specific diagnostic criteria. Red samples are usually indicative of needle trauma, but they may come from direct hemorrhage into the CSF as occurs in thrombo.

Pandy Test: This test is a simple technique for identifying inflammatory changes in the brain and meninges. In many cases this test is definitive. It is run in the following manner:

1. In test tube, place 1 cc. saturated phenol solution.

2. Layer ½ cc. of CSF on top of phenol solution.

3. Read within 20 seconds. The degree of bluish-white cloudiness at the interface of the two fluids is proportional to the amount of globulin in the CSF.

Normal fluids may show a faint trace but are usually clear. Any samples may become cloudy if allowed to stand.

To make a saturated phenol solution, place 10 cc. of melted phenol in a bottle with 90 cc. of distilled water.

Polioencephalomalacia gives a negative to very weak positive test.

Thromboembolic meningoencephalitis, in nearly all cases, is strongly or moderately positive.

Cytology: The number of cells in the CSF is an important diagnostic criterion. When combined with the differential white blood count, very definitive information is obtained.

1. Cell count should be done within 20 minutes after collection.

2. In a leukocyte-diluting pipette, draw diluting fluid up to the 1 mark. Fill to 11 mark with CSF.

3. Mix thoroughly and discard a few drops.

4. Fill both sides of a standard blood counting chamber and let it settle for a few minutes.

5. Count all cells within the ruled squares on both sides of the chamber and multiply by 0.6 for number of cells per cubic mm.

Diluting Fluid:
Glacial acetic acid, 10 ml.
Distilled water, 90 ml.
Crystal violet, 0.1 Gm.
Filter before use.

Normal count is under 25 cells per cubic mm.

Polioencephalomalacia tends to have counts between 25 and 100. Thrombo counts usually range over 200.

Differential cell count: The identification of the cell types in the CSF determines the character of the tissue reaction in the brain.

1. Count can be made from the cells present in the counting chamber using high magnification.

2. Another method is to certrifuge CSF for 5 minutes. Pour off supernatant and make smear from sediment. Dry stain with any blood stain.

Polioencephalomalacia characteristically has nearly all lymphocytes. Thromboembolic meningoencephalitis has mostly neutrophils with lymphocytes usually absent, but the lymphocytes may be as high as 30%.

Bacteriology: CSF may be cultured for bacteria, but our success has been limited and not worth the trouble.

Treatment of nervous disorders begins with proper hydration and nutrition. In our experience the best and most economically sound approach is daily pumping of water and nutrients into the rumen. Milk replacer is used in this clinic as nutrient if the animal cannot feed itself. With polio, fluid and nutritional support along with nursing care to teach the very sick to eat again often suffices. It also may be advisable to keep CSF pressure down with draining as necessary. Displacement of the eyes as described earlier may serve as an indicator for lowering the pressure. A word of warning! Many polio victims have prolonged clotting times; this should be checked before many CSF taps are made. Occasionally a polio case will hemorrhage and die from needle trauma around the medulla. There are reports in the literature of using thiamine and B complex vitamins to treat polio cases. We have been unsuccessful with their use in a limited number of cases. However, in view of the encouraging published reports, B vitamins may be useful as supportive therapy.

TREATMENT

For treatment of thrombo cases, fibrinolytic enzymes such as streptokinase with human plasminogen-streptodornase (*Varizymer*, American Cyanamid) 100,000 units are used for two days along with penicillin-streptomycin combination at a dosage of 10cc. (2 million units penicillin and 2.5 Gm. streptomycin) per 100 pounds of body weight daily. The dosage is divided into 10cc. injections that are administered intramuscularly and subcutaneously. This dosage is maintained for 4 days. A note of caution! If this treatment is inadvertently administered to a polio case, the animal

may hemorrhage to death internally because of disturbed blood clotting. Cerebrospinal fluid pressures are maintained at about normal with occasional taps as needed. Intrathecal antibiotic injections have been administered but were ineffective and increased the risk of contamination.

A few cases of streptococcal encephalitis and listeriosis have been admitted to the clinic. Thus far, these animals have been similar to thrombo on clinical examination with crebrospinal fluid analysis similar to polio. The animals were able to see and were aware of their surroundings. They had a tendency to wander aimlessly or circle. They seemed confused and often did not have the presence of mind to turn out of corners or back out of other confining situations such as hay mangers. Individual cranial nerve involvement was not as pronounced as with thrombo. The CSF had lymphocytes increased up to 200. Neutrophils were not seen. The Pandy Test was negative. Treatment consisted of 10 cc. penicillin-streptomycin per 100 lb. body weight daily for 4 days.

The differential diagnosis of neurological diseases is a practical reality. The client must realize that the technique requires time and skill on a par, perhaps, with abdominal surgery. Success and efficiency of treatment are the rewards of competent diagnosis. With accurate diagnosis and proper therapy, livestock owners can expect to reduce the extent of their losses from nervous system diseases. The savings to stockmen will be several times greater than the expenses required for veterinary service.

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Corrections

In Issue No. 2, Volume 28, 1966, there were errors in the article "The Adopted Curriculum Schedule" on page 55. These errors altered the context of the article. The corrections are as follows:

Page 55—The fall quarter schedule for the first year should include a one hour course in professional orientation which is required with no credit.

Page 55—The last paragraph was incorrect. The paragraph should read as follows: The preceding curriculum schedule and recommendations were presented to the faculty for approval. The curriculum schedule was approved and adopted by the College of Veterinary Medicine. The recommendations were not voted upon and will be considered by the faculty at a later date.