

MANAGEMENT OF NEUROSURGICAL CONDITIONS FOR VETERINARY TECHNICIANS

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Clinical syndromes seen in small animals with neurologic diseases are recognized generally from the history (acute vs. chronic onset, trauma and toxin exposure, observed clinical signs, progressive or static, pain, travel history, and vaccine status), signalment (breed, sex, and age), and neurologic examination (mentation, posture, gait, ambulatory function, postural reactions, palpation, limb and cranial nerve reflex testing).

The general aim of patient examination is to determine the neuroanatomic localization (brain, spinal cord, peripheral nervous system), assess the severity of the disorder, identify the disease process (eg. 'DAMNIT V' scheme), determine the most appropriate form of treatment, and to predict the prognosis.

Differential diagnoses can be categorized by location. Surgical intracranial diseases include caudal occipital malformation syndrome, compressive traumatic brain injuries, and brain tumors/abscesses, amongst others. Neurosurgical spinal diseases can also be classified by location: C1-5, C6-T2, T3-L3, L4-caudal. Examples include atlanto-axial instability, intervertebral disc herniation, cervical spondylomyelopathy, subarachnoid cysts, primary or secondary spinal tumors, vertebral fractures/luxations, and lumbosacral stenosis. Brain lesions can be approached via craniotomy procedure (rostromentorial, frontal, occipital), whereas spinal conditions are addressed using a variety of techniques (eg. hemilaminectomy, dorsal laminectomy, ventral slot, and fenestration).

An example of an anomalous intracranial surgical condition is congenital hydrocephalus. This condition is defined by excessive cerebrospinal fluid (CSF) in the ventricular system of the brain with no identifiable active cause leading to clinical signs of forebrain dysfunction (abnormal behavior and mentation). It most commonly occurs in young (within 6 months of age) toy and brachycephalic dogs. Typical physical characteristics include a large, dome shaped skull, 'open' fontanelles and bilateral ventrolateral strabismus. Diagnosis is based on demonstration of ventriculomegaly via CT/MRI or ultrasonography through a calvarial defect. Medical treatment (prednisone and omeprazole) consists of decreasing CSF production. Longer term management is successful in 50-90% of cases and involves surgical diversion of excessive CSF from the ventricles of the brain to the peritoneal cavity (ventriculoperitoneal shunting).

Another common example of a congenital structural abnormality is caudal occipital malformation syndrome (COMS), more commonly known as Chiari type 1 malformation. This disorder is characterized by a malformation of the caudal occipital region of the skull which leads to overcrowding of the caudal fossa. This disease is almost exclusive to young (3-6 years of age) small breed dogs, with Cavalier King Charles Spaniel being overrepresented. Although COMS may cause a variety of neurologic signs, cervical signs (neck pain and scratching) are common as most dogs with this condition have concurrent syringomyelia (an accumulation of fluid within the spinal cord). Diagnosis is made by MRI. The initial favorable response to medical treatment (analgesics and drugs to decrease CSF production) is oftentimes short lived and typically leads to euthanasia within 2 years due to disease progression. The surgical success rate via foramen magnum decompression is generally favorable but relapses are common in approximately 50% of cases due to scar tissue formation.

In addition to standard screening tests, the diagnosis of most neurosurgical conditions rely upon advanced neuroimaging techniques (myelography, computed tomography, magnetic resonance imaging).

Cerebrospinal fluid (CSF) for analysis is routinely acquired after advanced imaging due to the risk of inducing brain herniation. Fluid is collected from the cisterna magna or the lumbar region in a plain red top tube. However, in spinal patients undergoing myelography, CSF should be harvested prior to injection of contrast medium as this may induce a sterile meningitis that may confound subsequent interpretation of CSF analysis. Analysis of CSF should be performed within 30 minutes of collection as the cells deteriorate rapidly. In many cases, this is impossible and thus, the specimen should be split into two aliquots. One of the samples is put into a small EDTA tube. Alternatively, a drop of patient serum or equal volume of 4% formalin solution may be added in order to preserve the cell morphology.

Anesthetic agents alter normal CNS physiology which may be deleterious in patients with intracranial disorders. Premedication with benzodiazepines may help produce a smooth induction and provide short-term seizure control. Safer induction agents include thiobarbiturates and propofol as these reduce cerebral metabolic oxygen requirements and reduce intracranial pressure (avoid ketamine). Isoflurane or sevoflurane gas may be used as maintenance inhalant anesthetics. Arterial catheterization is crucial for direct blood pressure monitoring and periodic arterial blood sampling. Relative hyperventilation (PaCO₂ between 30-35 mm Hg) can help decrease intracranial pressure. Poor ventilation leads to increasing PaCO₂ which causes cerebral vessels to dilate. The increase in blood flow may lead to disastrous brain swelling and subsequent herniation. For craniotomies, most patients are in sternal recumbency; a head stand is used to stabilize the skull in an elevated position which minimizes pressure on the jugular veins.

Post operatively, patients should be recovered in an intensive care facility for the first 3-5 days and kept on a seizure watch. Blood gas analysis, serial neurologic examination (level of consciousness, mentation, pupil size, symmetry, and responsiveness), blood pressure and heart rate monitoring, and supportive care are indicated. Place the head at 30 degrees from the horizontal plane to maximize both venous drainage and arterial supply to the brain. Neurologic deterioration, seizures, herniation, hemorrhage, infection, and pneumonia are reported complications. Significant increases in intracranial pressure may lead to a paradoxical state known as the 'Cushing reflex', whereby a brain patient with neurological deterioration shows marked bradycardia with concomitant hypertension. Emergent treatment with mannitol and furosemide is indicated to prevent life threatening brain herniation.

Caring for patients with neurologic disease can be extremely challenging, especially if those patients are non ambulatory or only weakly ambulatory. A treatment protocol should be implemented at the onset of paresis or paralysis in order to prevent or lessen the severity of complications such as pulmonary atelectasis or pneumonia, urinary bladder damage and infections, decubital ulcers, muscle atrophy, joint stiffness, pain, and inadequate nutritional intake; undernourished patients are three times as likely as well-nourished patients to have major surgical complications.

It is of utmost importance to assess the respiratory patterns of recumbent patient throughout the course of treatment, to auscultate frequently, and to consistently monitor oxygenation status. Patients should be turned every 4 hours or kept in sternal position. Adequate analgesia is crucial as pain may cause changes in respiratory patterns and hypoventilation. Treatments for respiratory dysfunction secondary to recumbency include oxygen therapy, nebulization and coupage therapy, positioning techniques, sling therapy, and finally, mechanical ventilation if compromise

is severe. The goals of treatment for respiratory complications include prevention of respiratory secretions and accumulation, expansion of collapsed lungs, improved oxygenation, elimination of carbon dioxide, and patient comfort.

Other complications of the recumbent animal include development of pressure sores of decubital ulcers. These are local areas of skin necrosis. Pressure sores are often localized to bony prominences; localized pressure over these areas lead to tissue ischemia of variable severity (grade I – IV). Frequent turning of the patient and appropriate bedding represent the most important preventative measures of a nursing care protocol. Increased skin moisture and irritation contribute to the development of decubital ulcers. Therefore, patients should be kept clean and dry and should be bathed frequently. Since decubital ulcers are primarily caused by pressure, they can be avoided or minimized by using bedding (eg. sheepskin, foam or air mattresses, trampolines, or bandaging techniques). Raised and dry bedding are important also to prevent urine scalding.

Urinary complications are common in dogs and cats with neurologic dysfunction. Overdistention of the urinary bladder and urinary tract infections are typical consequences, both of which are avoidable with attentive nursing care. Proper technique in both expressing and catheterizing the bladder is important to prevent urethral and bladder wall trauma, to prevent introduction of bacteria into the urinary tract, and to measure urinary output in the oliguric or anuric patient as a guideline for appropriate fluid therapy. Overdistention of the bladder can result in permanent atony of the detrusor muscle. The bladder should be palpated to estimate size, even if there is urine present in the cage. The presence of urine in the patient's cage is not a reliable indicator of the ability to urinate voluntarily; the patient could have urinary overflow as a result of distention. The bladder should be expressed every 4-6 hours as a general rule. If the bladder cannot be expressed without minimal stress to the patient, a urinary catheter should be placed. Whether placing a closed urinary collection system or intermittently catheterizing the urinary bladder, the importance of aseptic technique for catheter placement cannot be overemphasized; if a closed urinary collection system (UCS) is used, the prepuce or vaginal area around the catheter should be swabbed every 12 hours with dilute chlorhexidine to minimize bacterial growth. Urinary collection bags should be changed every other day. Also, caution should be exercised when moving either the UCS or the patient to avoid urinary flow from the bag back to the patient. Urinary collection systems should be positioned at a level below the patient to ensure proper urine flow and kept from coming in direct contact with the hospital floor. Regardless, the best way to avoid urinary tract infection is to remove the catheter as soon as it is feasible to do so. Approximately one-half of dogs catheterized for 4 days or longer will develop a urinary tract infection.

The major goals of physical therapy (PT) are to attain or maintain full range of motion, minimize muscle atrophy, and prevent or ameliorate patient discomfort. Traditional therapies of hot packing, cold packing, massage, and simple stretching exercises in veterinary medicine have been supplemented by more advanced treatments, such as hydrotherapy, ultrasound, electrical stimulation, sling supported exercise, and acupuncture. There is an increasing demand for prolonged postoperative care in dogs and cats, reflective of advancements in veterinary neurosurgery. Emphasis on such physical therapeutics can result in shorter hospitalization periods and improved patient well-being. A plan for physical therapy should be discussed between veterinarian, technician, and owner, in order to provide the best rehabilitation program. Benefits of PT include improved circulation, increased production of collagen, decreased inflammation, decreased muscle atrophy, and prevention of joint stiffness. There is no absolute

'recipe' for a particular condition or surgery – every PT regimen is tailor-made to the individual patient. Regardless, most rehabilitation programs will include the following modalities: cryotherapy, heat therapy, stretching, passive-range-of-motion, sling therapy, active physical therapy (eg. exercise ball, hydrotherapy).

References

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