Rehabilitation of Neurologic Patients

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Normal movement of the limbs is a complex interaction of a number of body systems. The neurologic system is responsible for the intricate sensing and coordination of movement. Neurologic abnormalities can result in altered gait, weakness or pain. A diagnosis can be challenging but it is important to start with a good general physical examination followed by a complete neurological examination.

Postural reactions test both sensory and motor function and are helpful for identifying deficits in strength and coordination. Conscious proprioception assessment is done by repeatedly placing the weight-bearing part of the paw on the dorsal aspect and watching for the animal to quickly replace it into normal position. You may need to support some of their body weight. Although not always reliable, it can help differentiate between a neurologic versus orthopedic problem. Hop the animal laterally on each limb. A delay in initiation suggests proprioception deficits, while the ability to support weight assesses motor function and strength. Deep pain is assessed by toe pinching until a behavioral response is elicited; indicating pain. Assessing muscle tone (flaccid or spastic) will help differentiate between UMN and LMN.

If gait and postural reactions are normal, spinal reflexes will generally be normal. The most consistent reflexes in the hind limb are the withdrawal or flexor reflex and patellar reflexes. Positive response to toe pinching tests the sciatic nerve and it's associated spinal cord segments (L6-S1). A positive patellar response is stifle extension, which testes the femoral nerve and spinal cord segments (L4-L6). Keep in mind stifle disease will weaken the patellar reflex. The most reliable thoracic limb reflex is the withdrawal reflex. It assesses the musculocutaneous, median, ulnar, radial and axillary nerves and spinal cords segments C6-T2. The perineal reflex assesses S1-S3. The panniculus is used to help localize a spinal cord lesion. If a response is absent, remember the lesion is 1-2 vertebra cranial to this level as the sensory nerves travel slightly cranially before synapsing. Tips: animals with neck pain may 'guard' the neck. Thoracolumbar pain may resemble abdominal pain. Lumbosacral pain may cause reluctance to urinate or defecate and upon palpation the patient may immediately sit down.

The most commonly encountered spinal conditions affecting small animals are: IVDD Types I & II, atlantoaxial luxation/subluxation, caudal cervical spondylomyelopathy (wobblers syndrome), lumbosacral conditions, fibrocartilaginous embolism (FCE), degenerative myelopathy (DM), discospondylitis, and vertebral body abnormalities. Due to time constraints this lecture will cover thoracolumbar IVDD, FCE and DM in depth.

Thoracolumbar disk disease

Protrusion or extrusion of an intervertebral disk is a common cause of pain and weakness in dogs. There are two types of disk degeneration. Type I extrusion is characterized by decrease in water and glycosaminoglycan content in the disk resulting in calcification of the disk. This can start as early as two months of age and is common in chondrodystrophic breeds. Type II degeneration is characterized by replacement of the disk with fibrous tissue and is most common in older, large breed dogs. The clinical signs of Type I disks are typically less severe with a slower onset. Disk disease most commonly occurs near the thoracolumbar region at T12-13 to L1-2, although other areas may also be affected. Surgical removal of extruded disk material is indicated in patients with substantial neurologic deficits.

Rehabilitation can be used with conservative management of IVDD, however treatment is most often done with the patient post operatively. The focus is pain control in the immediate postoperative period. Cryotherapy can be applied to the incision. Ice packs, cold packs, or ice compression units are commonly used as forms of cryotherapy. Homemade ice packs can be made by freezing one part alcohol with two parts water in a double sealed plastic bag. Cryotherapy only penetrates one to two centimeters of tissue depth so its effects are more pronounced in the skin. Compression increases cold penetration. This can be done a few different ways: by maintaining a cold pack in position with an elastic bandage or using a commercial grade compression unit. Care should be taken when adding compression as patients may have signs of hyperesthesia. Cryotherapy, used in the acute post-op or post-injury period, is best used within 72 hours. It is used for about 20 – 30 minutes three to four times daily while monitoring the skin for irritation and discomfort.

Low level light laser is helpful in the early stages of treatment to help control pain and expedite healing. The effects of pain relief are due to the result of enhanced endorphin release. Laser therapy is measured in joules (energy delivered by one watt of laser energy in one second). Most therapies call for one to eight joules of energy. Early in treatment lower energy is required but can be increased later in the recovery process. Laser can be also be applied to the incision site to encourage more rapid healing.

Passive range of motion is a motion that is performed without a muscle contraction. Additional pressure at the end of the ROM is stretching. PROM helps prevent joint contracture, soft tissue shortening, maintain mobility between soft tissue layers, enhance blood and lymph flow and improve synovial fluid production and diffusion. It is important for the therapist to maintain a range of motion that is within the patient's comfort range and not injures the tissues by exceeding the comfort limits. Ideally PROM should be performed in a quiet environment with the patient comfortable and relaxed in lateral recumbency. It is best to involve only one joint at a time while keeping the other joints in neutral position. The movements should start slowly and progress until the endpoint of the

range of motion is reached. Apply gentle pressure for 15-30 seconds at the end of flexion and extension to add stretching to the treatment. It is recommended to perform 15-20 repetitions two to four times a day.

Exercises should focus on balance and strengthening. Standing exercises can begin as soon as treatment begins. Support can be given using slings or physiorolls. With the patient standing, gentle pressure can be applied to the dorsal aspect of the pelvis. This will help the patient maintain a standing position for a longer period of time. Moving the hind limbs in a reciprocal walking pattern can mimic assisted walking. This can also be done on a land treadmill or in an underwater treadmill. In the under water treadmill, the buoyancy provides support so a very weak animal can stand with the water's support. Water depth can be adjusted to change the effect of buoyancy on the animal. The increased resistance (60%) causes the limbs to work harder, thereby providing a more efficient workout. The warm water increases circulation, alleviates pain and causes peripheral vasodilation, which increases cardiovascular demand. Animals should be monitored for signs of fatigue, as hydrotherapy can be quite strenuous.

NMES can be applied to the hind limbs and/or trunk muscles to help inhibit muscle atrophy. Neuromuscular electrical stimulation (NMES) is used to rehabilitate or strengthen muscles by stimulating the nerve that causes the muscles to contract. It is very useful in painful, weak or atrophied animals. NMES is effective in promoting muscle re-education in cases of prolonged disuse however the recruitment of muscle fibers is not the same as for voluntary muscle contraction, and the amount of stimulation needed to really strengthen muscle may be too uncomfortable to the patient. NMES will only generate 80-90% of maximal voluntary muscle contraction, therefore exercise is preferred over NMES whenever possible. Depending on the patients ability NMES can be applied while in lateral recumbency, or added to a therapeutic exercise for a better muscle contraction and more challenging exercise. An example of this is applying NMES to the gluteals with the patient supported over a physioroll adding weight shifts with the muscle contraction. NMES should not be used in patients with a pacemaker, in animals with seizure disorders, or over areas of thrombosis, infection or neoplasia.

As the patient progresses in treatment, changes to the treatment plan should be made to make the sessions more challenging. Exercises such as figure 8s, assisted or unassisted sit to stands, walking on an air mattress, cavaletti rails, etc. can be added. Exercises should be added to strengthen the core muscles. This can be done with contralateral limb standing or plank (have the animal stand with its front limbs supported higher than its hind limbs. A physioroll or high step can be used. Home exercises should also be given. It is important to be sure the owner has a full understanding how to perform the assigned exercises. Have the owner practice the exercise before sending them home with written instructions.

Fibrocartilaginous embolic myelopathy

Fibrocartilaginous embolism is the most common vascular spinal cord condition in the dog. FCE occurs when a cartilaginous embolism lodges in a spinal vessel. Clinical signs are acute onset, non-progressive and non-painful neurological deficits. Onset often occurs during physical activity and neurological deficits usually stabilize by 24 hours. Specific neurological signs are dependent on the anatomical distribution of the FCE and the severity of the resultant ischemia. FCE usually affects brachial or lumbosacral intumescences and lateralization is common. Until recently diagnosis was by exclusion, however MRI is shown to demonstrate spinal cord ischemia. Prognosis is generally good: however, a poorer prognosis is reported for older, large breed dogs.

Rehabilitation is beneficial for patients recovering from FCE. Techniques and modalities similar to those used in IVDD rehabilitation are used. Techniques vary depending on the location of the lesion and the degree of damage to the spinal cord. Patients may have increased spasticity and muscle tone or decreased muscle tone and flaccidity. In general, passive range of motion, NMES, hydrotherapy, low level light laser, and therapeutic exercises are indicated. For animals that are tetraparetic, assistance can be given to mimic normal daily activates. The animal can be assisted from lateral recumbency to laying sternal; sternal to sitting; and sitting to standing. Once the patient is in an assisted standing position toe tickles or pinches can be used to move the limbs in a normal walking pattern. Several short sessions of this exercise should be done throughout the day, as patients will fatigue quickly.

Degenerative myelopathy

Degenerative myelopathy slowly causes progressive ataxia and weakness. The white matter of the spinal cord contains fibers that transmit movement commands from the brain to the limbs and sensory information from the limbs to the brain. Degeneration of this matter consists of both demyelination (stripping away the insulation of these fibers) and axonal loss (loss of the actual fibers), and interferes with the communication between the brain and limbs. Recent research has identified a mutation in a gene that confers a greatly increased risk of developing the disease. Early signs of DM are ataxia and spastic paresis in the pelvic limbs. Worn nails and asymmetric pelvic limb lameness can also be seen. As the disease progresses, LMN paraplegia will occur and the thoracic limbs will be affected. Rehabilitation may improve the quality of life for the DM affected pet and pet owner. Overall, the long-term prognosis for DM is poor.

In the early stages of the disease, exercises should be done to maintain or increase muscle mass and challenge proprioception and balance. Cavaletti rails, figure 8s, sit to stand, backward and sideways walking, etc. can be done. A home exercise program should be given. NMES can be used during sessions to help maintain muscle mass. Low level light laser can be used on the spine and applied to trigger points. Hydrotherapy can also be beneficial for strengthening and challenging coordination. As the disease progresses, owners

can be directed with assistive devices such as wheel chairs or carts. Diapers, booties and special bedding may also be needed. Guidance may also be needed to make an end of life decision.

Caudal cervical spondylomyelopathy

Treatment of these patients is aimed at alleviation of the symptoms. Caution should be used when attempting any type of treatment. Usually these patients have a stiff neck and are painful on manipulation. They have severe neck and back muscle tension with secondary limb tension. Ataxia and proprioceptive deficits vary in severity depending on the lesion and the patient. To control pain and muscle tension hyperthermia or cryotherapy, low level light laser, ultrasound, gentle massage and TENS are used. Active and passive exercises help with ataxia and proprioceptive deficits.