Diffuse Lower Motor Neuron Dysfunction in Dogs

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You have asked…

A canine patient presented with sudden-onset pelvic limb weakness that rapidly progressed to inability to walk. Segmental reflexes were absent in all limbs. What differential diagnoses should be considered?

The expert says…

A patient presenting with these signs may have a diffuse lower motor neuron (LMN) disorder (ie, diffuse neuromuscular disease) based on the absence of myotatic and withdrawal reflexes in all limbs.

Diffuse LMN signs may result from generalized muscle dysfunction; neuromuscular junction disorders; or disease of the peripheral motor nerves, ventral (motor) nerve roots, or motor neurons within the spinal cord. Diffuse spinal cord disease is also possible in these patients but is less common than diffuse neuromuscular disease. Although ataxia and paraspinal hyperesthesia are occasionally observed in patients with diffuse neuromuscular disease, both signs are more likely with spinal cord dysfunction than with a generalized peripheral LMN disorder. This distinction can help practitioners differentiate diffuse spinal cord disease from neuromuscular disease.

The differential list for LMN dysfunction is varied (see **LMN Dysfunction: Differentials & Considerations**, next page), and regional risk conditions (eg, coral snake envenomation) should

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Acute Diffuse LMN Dysfunction: 4 Common Differential Diagnoses

1. Acute idiopathic polyradiculoneuritis or coonhound paralysis
2. Tick paralysis
3. Botulism
4. Fulminant (acute) myasthenia gravis

LMN = lower motor neuron

be considered, but 4 of the most common causes of acute diffuse LMN dysfunction are acute idiopathic polyradiculoneuritis or coonhound paralysis,[1] tick paralysis, botulism, and fulminant (acute) myasthenia gravis.

1. Acute Idiopathic Polyradiculoneuritis or Coonhound Paralysis

Acute idiopathic polyradiculoneuritis is an inflammatory disorder that primarily affects the axons and myelin of the ventral roots and shares the same clinical and pathologic features of Guillain-Barré syndrome in humans.[2] The inciting cause is unknown, but theories include recent illness or vaccination, immune-mediated disease, and viral infection. A recent retrospective study demonstrated that dogs with this condition were more likely to have positive serum IgG titers for *Toxoplasma gondii* than were dogs not affected by this condition, suggesting that *T gondii* may be an inciting trigger.[1]

Coonhound paralysis appears to be an identical clinical disease in dogs that have been exposed to raccoon bites or scratches 7 to 10 days before onset of clinical signs. Salivary antigen may trigger the condition. In both diseases, the history typically reflects sudden onset of pelvic limb weakness that progresses to nonambulatory tetraparesis within 48 to 72 hours.

Neurologic examination (**Table**) may reveal flaccid tetraparesis or tetraplegia, decreased to absent myotatic reflexes, and decreased to absent withdrawal. Loss of voice or change in bark is common, and some patients have facial weakness. Typically, these patients do not become incontinent, and their sensory function remains intact; some may appear hyperesthetic.

Diagnosis

Diagnosis is based on history, potential exposure to raccoons, and neurologic examination findings. Electrodiagnostics can be helpful, but abnormalities in electrical activity do not develop until 5 to 7 days after onset of signs. Abnormal spontaneous electrical activity is frequently detected on electromyography, and motor nerve compound muscle action potentials and nerve conduction velocity are often diminished. A special type of nerve conduction study (ie, F wave) that assesses transmission through the ventral roots may be abnormal, suggesting disease of the ventral roots. Cerebrospinal fluid often demonstrates an elevated protein level.[2]

Treatment

Treatment is centered on intensive nursing care (eg, hydration, nutritional support, prevention of pressure sores, recumbent patient care) and physical rehabilitation. Most patients do not have urinary or fecal incontinence, but an indwelling urinary catheter should be considered to lower risk for urine scald. Although this disease has inflammatory attributes, glucocorticoids have not been shown to shorten disease duration or improve degree of recovery; furthermore, glucocorticoids can worsen the weakness. In human medicine, plasma exchange (plasmapheresis) and high-dose intravenous immunoglobulin

LMN Dysfunction: Differentials & Considerations

- Acute polyradiculoneuritis
- Antibacterial-associated neurotransmission disorder
- Degenerative myopathy
- Distal denervating disease
- Envenomation (eg, coral snake)
- Fulminant myasthenia gravis
- Ionophore toxicity (eg, monensin)
- Lead toxicity
- Metabolic disorder (eg, Addison's disease [hypoadrenocorticism], diabetes mellitus)
- *Neospora caninum* and *Toxoplasma gondii* parasitism
- Organophosphate and carbamate toxicity
- Polymyositis
- Tick paralysis

(IVIG) therapy are commonly used for patients with Guillain-Barré syndrome. Data are limited as to whether IVIG therapy shortens the duration of signs or improves degree of recovery in dogs.[3] In addition, plasmapheresis is available in few veterinary practices, and IVIG can be difficult to acquire; both can be cost prohibitive.

The most important monitoring parameter for these patients is ventilation, as signs can progress over 5 to 7 days; some patients develop respiratory muscle weakness from involvement of the phrenic nerve and intercostal nerves. These patients may require mechanical ventilation, but most will eventually recover if they do not develop pneumonia or other complications.

The prognosis is good to excellent with intensive nursing care and physical rehabilitation; however, complete recovery may take several weeks to months. Clients should be instructed to avoid exposure to raccoons or other factors that may have triggered the clinical signs, as survival does not confer immunity.

2. Tick Paralysis

Tick paralysis is characterized by a flaccid, rapidly ascending LMN paralysis in dogs following exposure to salivary neurotoxin released by adult ticks. *Dermacentor variabilis* (American dog tick, common wood tick) and *D andersoni* (Rocky Mountain wood tick) are most commonly implicated in the United States. Affected dogs typically display signs 5 to 9 days after tick attachment and present with paraparesis that rapidly progresses to tetraparesis within 12 to 72 hours of onset of signs.

Diagnosis

Diagnosis is based on removing an engorged tick, followed by rapid resolution of signs. Failure to find a tick does not rule out tick paralysis (eg, the tick may have dropped off). The patient should be treated with an acaricide (tick dip) if available. If an acaricide is not readily available, the patient should be shaved completely in search for ticks. Manually locating ticks in dogs with long hair coats is unreliable. Inner pinnae, under the tail, and perivulvar and interdigital regions (ie, locations where ticks

Table **Common Neurologic Examination Findings***

Sign	*Acute Idiopathic Polyradiculoneuritis or Coonhound Paralysis*	*Tick Paralysis*	*Botulism*	*Fulminant (Acute) Myasthenia Gravis*
Cranial nerve involvement	± Facial paresis, dysphonia	± Dysphonia	± Dysphonia, megaesophagus, gagging/retching, mydriasis, decreased pupillary light reflex	± Dysphonia, megaesophagus, gagging/retching, facial weakness
Postural reactions	Usually absent	Usually absent	Usually absent	Often absent but may be normal with support in milder cases
Segmental myotatic & withdrawal reflexes	Decreased to absent	Decreased to absent	Decreased to absent	Usually decreased but may be normal in milder cases
Weakness	Tetraparesis to tetraplegia	Tetraparesis to tetraplegia	Tetraparesis to tetraplegia	Tetraparesis to tetraplegia
Other common signs	± Hyperesthesia	None	Decreased mentation, urine retention or incontinence, constipation, kerato-conjunctivitis sicca, altered heart rate	± Aspiration pneumonia, urine retention

*These clinical findings should not be used as the sole method to determine which disease is present. Advanced diagnostics (eg, electromyography, nerve conduction studies, spinal fluid analysis, MRI) should be recommended, as they are required to definitively diagnose the cause of diffuse LMN disease.

ACh = acetylcholine, IVIG = intravenous immunoglobulin, LMN = lower motor neuron, MG = myasthenia gravis

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Patients with fulminant MG often present as laterally recumbent nonambulatory tetraparetics.

are frequently encountered) should be closely scrutinized. Investigation should not stop after an engorged tick is found; there is often more than one tick on an affected patient.

Treatment

Improvement is often noted within hours of tick removal, and full recovery can occur within 2 to 3 days. Spot-on tick treatment should not be the sole measure, as spot-on treatment can require 36 to 48 hours to take effect, during which time respiratory paralysis or aspiration pneumonia may develop. There is little value in performing tick serology for suspected tick paralysis. A positive test result simply suggests tick exposure at some point in the past (potentially months to years) that led to tick-borne infection, not necessarily the same tick causing the current signs. If the test proves negative, the patient could still have tick paralysis.

3. Botulism

Botulism is caused by ingestion of a preformed neurotoxin produced by *Clostridium botulinum*. This organism produces multiple exotoxins, but type C neurotoxin has been implicated most commonly in canine botulism. The toxin is most likely ingested through contaminated carrion or uncooked, spoiled food. In rare cases, the organism produces the exotoxin after colonization of the GI tract. After absorption from the upper GI tract, the neurotoxin enters the circulatory system and is internalized into the nerve terminal of presynaptic neurons, where it binds to synaptic vesicle fusion proteins (syntaxin, synaptobrevin). This prevents fusion of neurotransmitter vesicles to the presynaptic membrane, thereby blocking release of acetylcholine (ACh) at both the neuromuscular junction and cholinergic synapses in the autonomic nervous system.

Onset of clinical signs occurs within 12 hours of ingestion. Clinical signs often appear as progressive weakness to flaccid paralysis, starting in the pelvic limbs and rapidly progressing to the thoracic limbs. Pain perception in the limbs remains intact. In severe cases, respiratory paralysis can lead to death. Unlike the other LMN diseases described in this article, cranial nerve deficits are common, including facial nerve paralysis, decreased gag reflex, decreased jaw tone, and megaesophagus. Autonomic nervous system signs also are common, including altered heart rate, dilated pupils with decreased pupillary light reflex, keratoconjunctivitis sicca, urine retention, and constipation.

Diagnosis

Presumptive diagnosis is based on evaluation of signs and potential exposure. Definitive diagnosis requires identification of the neurotoxin in blood, feces, vomitus, or food. Electrodiagnostics can help distinguish botulism from other diseases.

Treatment

Treatment consists of routine nursing care, physical therapy, and bladder and bowel care. Type C antitoxin is difficult to obtain, must be given within the first few days (before the toxin has internalized into neurons), and has uncertain therapeutic benefit. Trivalent antitoxins (types A, B, and E) do not appear to be beneficial. Patients do not develop immunity, but repeat exposure is rare.

4. Fulminant (Acute) Myasthenia Gravis

This uncommon form of acquired myasthenia gravis (MG; see **Types of Myasthenia Gravis**) can produce severe, rapidly progressive generalized muscle weakness. Acquired MG is caused by antibodies directed against the ACh receptor on skeletal muscle, resulting in decreased receptors available for ACh binding and subsequent muscle weakness.

Patients with fulminant MG often present as laterally recumbent nonambulatory tetraparetics. They may have normal to only mildly decreased myotatic spinal reflexes, whereas patients with the other 3 described disorders usually have markedly reduced reflexes. Aspiration pneumonia, a result of laryngeal and pharyngeal weakness, is common. These patients often appear systemically ill.

ACh = acetylcholine, IVIG = intravenous immunoglobulin, LMN = lower motor neuron, MG = myasthenia gravis

Diagnosis

Definitive diagnosis is based on demonstration of anti-ACh receptor antibodies in serum. Tensilon testing (edrophonium challenge) often yields a false-negative result because of the weakness severity; false-positive results are also possible, although a dramatic improvement in strength would be more common with MG than with other disorders. Thoracic radiographs should be examined for megaesophagus, aspiration pneumonia, or thymoma. Routine screening tests (eg, CBC, serum biochemistry profile, abdominal ultrasonography) are often normal but should be performed to search for an underlying cause and to rule out other causes of generalized weakness. Electrodiagnostic testing (ie, repetitive nerve stimulation or single-fiber electromyography) may support a diagnosis of MG.

Treatment

Treatment involves intensive care with anticholinesterase therapy (eg, oral pyridostigmine, injectable neostigmine), potentially immunosuppressive medications (used cautiously if aspiration pneumonia is present and with the knowledge that corticosteroids can cause additional neuromuscular weakness), IV fluids, and nutritional support. Plasmapheresis and/or IVIG therapy may help but are used infrequently because of cost and limited availability. This form of MG has a high mortality. ■ cb

Types of Myasthenia Gravis

- **Focal**
  Megaesophagus ± facial, pharyngeal, or laryngeal weakness
- **Fulminant**
  Profound appendicular muscle weakness with varying degrees of cranial nerve involvement, acute onset, and rapid ascending tetraparesis and respiratory distress
- **Generalized**
  Predominantly pelvic limb involvement with mild-to-moderate weakness (often present in thoracic limbs) and megaesophagus

See **Aids & Resources,** back page, for references & suggested reading.