Healing Paralytic Neurologic Disease in a Dog: An Integrative Approach

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Abbreviations

IVDD	Intervertebral disc disease
NMES	Neuromuscular electrical stimulation
NO	Nitric oxide

A 5-kg, 11-year-old male neutered Chihuahua cross, previously owned but abandoned, presented to the San Diego Humane Society in November 2020. On initial examination, the dog was found to be generally healthy except for generalized dander and "flystrike" on the ear tips, for which he was prescribed a combination antibiotic and steroid ointment. As is customary for the facility, he was comprehensively vaccinated and dewormed.

On day 7, while still at the humane society, the dog experienced marked abdominal distention, apparently following the consumption of 3 servings of food at once. Abdominal radiographs revealed no other abnormalities, and for the next 4 days, the patient was prescribed a restricted diet consisting of ¼ cup of a popular processed dry kibble twice daily. Also at that time, he was diagnosed with bilateral grade 1 to 2 medial patellar luxation that was producing an intermittent skipping gait. No treatment was deemed necessary.

Approximately 1 week later, the dog was transferred to a senior dog rescue agency. On day 21, he experienced urinary incontinence with increased thirst. By day 22, acute hind limb paralysis and priapism were noted. Bloating was still visible on presentation to urgent care, and the dog was unable to urinate. Results of a urinalysis, CBC, serum chemistry, thyroid levels, and Spec cPL® (a) testing were all normal. Radiographs suggested a narrowed intervertebral disc space at T12-T13, and varying degrees of spondylosis were seen in cranial lumbar vertebrae, most notably from L1 to L2. Hind limb deep pain perception was present. Eye redness was noted, for which the dog was prescribed eye drops.

The limited financial resources of the rescue agency prohibited further imaging studies or any contemplation of surgical treatment. The dog was initially treated with pharmaceuticals, as the attending veterinarian was concerned about the presence of intervertebral disc disease (IVDD). Although the dog was reportedly painless, buprenorphine was infused intravenously, along with methocarbamol and dexamethasone (doses not reported). He was discharged the evening of day 22 with prescriptions for prednisone (2.5 mg, PO, BID) and methocarbamol (125 mg, PO, BID).

Over the next few days, the patient's condition worsened with the onset of full-body spasms that confined him to lateral recumbency and extensor rigidity. The bladder remained difficult to express. The methocarbamol dose was doubled to 250 mg BID. The dog appeared "spacey" and disconnected from his surroundings but would panic if efforts were made to get him to stand for bladder expression.

Around day 29, the rigidity subsided and the patient was able to partially urinate on his own. The left hind leg was paretic, and the right hind leg was paralyzed. The dog's mentation still appeared to be "spacey." Neuromuscular electrical stimulation (NMES) was initiated by a care provider within the rescue agency in an effort to expedite recovery. A very low current was used, delivered in 20-second pulses through pads situated on either side of the spine at the presumed level of spinal injury. Within hours of the NMES treatments, multiple seizures were noted, with paddling of all limbs, unresponsiveness, and urinary incontinence. On day 34, he was re-evaluated at an urgent care facility and prescribed potassium bromide (dose unknown)

for the seizures as well as a short course of amoxicillin/clavulanic acid (dose unknown) for a presumed urinary tract infection. Prednisone, methocarbamol, and NMES were discontinued. No further seizures were observed.

Day 35 saw improvements in the dog's mentation and the caregiver's ability to express the bladder. His priapism seemed improved as well, and the dog was transferred to his foster owner to continue convalescence. These improvements in mentation, priapism, and bladder expression were maintained until day 58 when the dog was presented to the initial veterinary hospital for evaluation of repeated overnight urinary incontinence. Urinalysis revealed pyuria, and enrofloxacin (dose unknown) was prescribed. Testing revealed that serum bromide levels were too low to prevent seizures (although no additional ones had been observed), and the dose of the drug was increased. The dog was still unable to bear weight on his hind legs.

By day 70, progress seemed to have nearly plateaued for this patient. Hind limb movement was noted sporadically, and the dog could be fleetingly propped into a standing position while eating before sagging to the floor within a second or so. Otherwise, the patient just dragged his hind limbs either on the floor or in a cart (**Figure 1**). Muscle tension in the neck and trunk was recurring from time to time, and manual expression of the bladder was still difficult (**Video 1**). An integrative medical assessment with a focus on Chinese medicine was sought from the author before committing more resources to a conventional workup and treatment.

The Chinese medical exam performed on day 72 revealed broad, superficial, and toned (or so-called Floating) femoral pulses that moderated following gentle mobilization of fixated thoracic and lumbar spinal segments using an Activator II (b). The pulse was further moderated and then maintained towards normal with dry needle tonification of acupoint BL 23 and sedation of acupoints BL 18 and BL 40. A Chinese medical diagnosis of Kidney Deficiency leading to acute Wind invasion, ie, *Tai Yang* Excess due to underlying Deficiency, was rendered. *Du Huo Ji Sheng Tang* (Pubescent Angelica and Loranthus Combination) (c) was prescribed at a dose of 250 mg PO, BID to TID. In addition, the above-noted acupuncture protocol was continued, along with veterinary chiropractic mobilization of the dog's spinal column at approximately weekly intervals for the next 4 months. A home-cooked, meat- and vegetable-based diet was introduced around day 107 (week 5 of integrative care) to replace the kibble diet. Potassium bromide was discontinued gradually over several weeks. Between treatments, the foster owner was instructed to gently massage and mobilize the dog's spine for a few minutes daily and stimulate conscious movement in his hind end by trying to lure him forward with treats. Initially, the dog was in his cart for these sessions, but as soon as consistent, conscious limb movement and ability to bear weight for several seconds were attained, he was removed from the cart and encouraged to move forward on the grass unassisted.

The previously reported whole-body spasms resolved immediately upon initiation of treatment. Within 2 days of the first acupuncture session, on day 74, the dog began consistently attempting to walk with his hind legs while being exercised in the cart (**Figure 2, Video 2**). By day 91 (3 weeks of integrative care), the patient could stand for approximately 15 seconds at a time, although he was not yet able to walk without the cart.

Figure 1

Patient at the start of integrative treatment, 2 months after the onset of illness.

Figure 2

Patient 3 to 4 months post-initiation of integrative care, 5 to 6 months after initial onset.

He could urinate on his own. On day 172, the dog had improved to the point that he could take 4 to 10 steps unassisted, although he was still unable to rise on his own. A few days later, he could push himself briefly to a standing position if he had free use of his left hind leg. The priapism also began to reduce around this time. By day 202, the patient could walk a dozen steps at a time. By day 232, he was able to walk largely normally on grass and carpeted surfaces and could ascend stairs with minimal assistance. Veterinary chiropractic and acupuncture treatments were reduced to every few weeks, with priapism occurring intermittently between the visits. In between treatments, mobility and function were maintained solely with the home-cooked diet and continued use of the herbal formula (**Videos 3 and 4**).

Comments

IVDD is the most common cause of hindlimb paralysis in dogs. The majority of canine disc disease occurs between T11 and L1 and can be of 2 types (1). Hansen type I disease consists of abrupt disc herniation causing cord compression and contusion, setting in motion intra-neuronal changes that can result in axonal degeneration and death. Hansen type II disc disease constitutes a gradual protrusion of the annulus into the spinal canal to impinge on the cord. It usually occurs in large breed dogs and is of a milder severity than Hansen type I disc disease. Signs can be graded according to the schema below, to provide a guide in assessing the severity of cord injury and whether surgery is indicated for recovery:

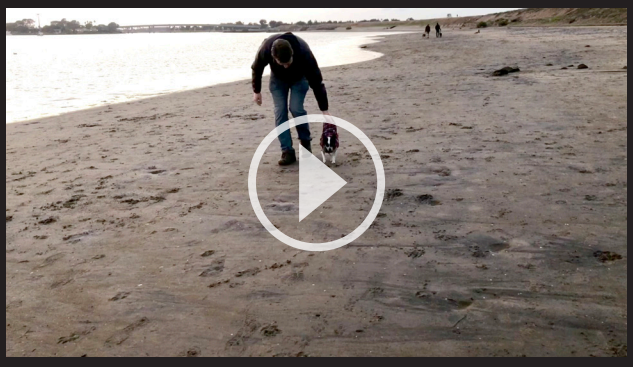
- Grade 1: Pain only
- Grade 2: Ataxia, conscious proprioceptive deficits, paresis
- Grade 3: Paraplegia
- Grade 4: Paraplegia, urinary retention and overflow
- Grade 5: Paraplegia, urinary retention and overflow, loss of deep pain perception

Per this schema, type II Hansen would generally present as lower grade cases and type I cases as higher grade.

Differential diagnoses for IVDD include fibrocartilaginous embolism, spinal trauma, spinal neoplasia, degenerative myelopathy, discospondylitis, and inflammatory myelitis. Survey radiographs of the spine are a common first step in working up a case of hindlimb paralysis since areas of obvious intervertebral space collapse and disc calcification raise the possibility that IVDD is present. If none are seen or if surgery is contemplated, myelography, CT scans, or MRIs are necessary to confirm the diagnosis and the location of the lesion. Surgical intervention is reserved for cases refractory to conservative medical management and for patients graded 3 through 5. Prognosis without surgical intervention in animals that have reduced deep pain sensation in the hind limbs is guarded to poor (2).

The above notwithstanding, most cases with a working diagnosis of disc disease are managed medically at first, often using some combination of corticosteroids, muscle relaxants, pain relievers, and NSAIDs. In addition to analgesia, the focus of acute medical care is on the reduction of nitric oxide (NO) elaborated within the cord in response to any spinal trauma, including surgery (3, 4). Some of the NO is elaborated by WBCs entering the damaged area, and some is produced by the neurons themselves. The NO serves a purpose in that it activates nociception pathways, but it becomes neurotoxic at high levels, damaging the cord (5). A return to function demands subsidence of

Video 1



Day 70, 1.5 months after conventional treatment was initiated and 2 days prior to the start of integrative treatment. Note flaccidity of hind limbs.

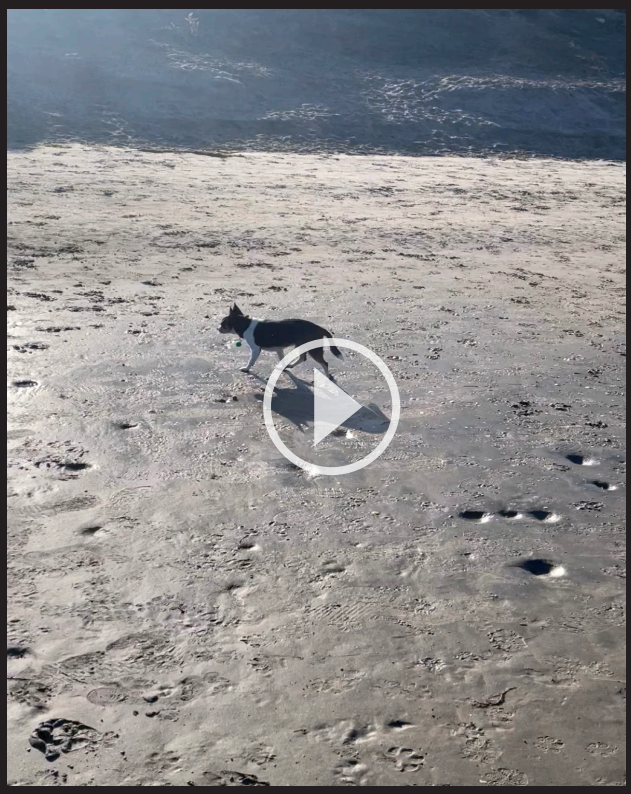
Video 2

Day 74, 2 days after beginning integrative treatment. Note the consistent purposeful stepping of hind limbs.

Video 3

Day 244, 6 months after integrative treatment was begun.

Video 4



Day 337, 9 months after integrative treatment was begun. Only herbs and diet remain in consistent use. Mild intermittent priapism occurs unless consistent acupuncture and veterinary chiropractic treatments continue.

these high NO levels (6). If instead high NO levels persist, neuronal degeneration occurs.

Pharmaceutical approaches to lower neuronal NO have not been developed, but corticosteroid therapy is commonly used immediately after cord injury despite uncertainty about its efficacy. In humans, it has the effect of limiting NO elaborated by WBCs, reducing any associated pain in the process and helping to facilitate a return of motor function (7, 8). Bupleurum, a chief component in herbal therapies commonly employed for acute neural injury, seems to likewise suppress the NO-cyclic guanosine monophosphate (NO-cGMP) pathway that can otherwise inhibit cord healing (9). Cases calling for the use of bupleurum-laden formulas such as X*iao Chai Hu Tang* (Minor Bupleurum Combination), *Chai Hu Jia Long Gu Mu Li Tang* (Bupleurum, Dragon Bone, and Oyster Shell Combination), and *Chai Ge Jie Ji Tang* (Bupleurum and Kudzu Combination), present differently to the one related here. In the author's experience, peripheral circulation in acute cases is often palpably engorged, represented by a so-called Full, Flooding, or Drum Skin pulse. Such pulses are typically seen with acute neurological inflammation such as in meningoencephalitis, discospondylitis, fibrocartilaginous embolism, and disc disease of up to a few days' duration. The pulse in these animals is almost invariably responsive to stimulation of Gall Bladder acupoints like GB 20, BL 19, GB 21, and GB 34, pointing to a need for an acute-acting anti-inflammatory bupleurum-based formula.

Once acute inflammation following disc prolapse has had time to subside, veterinarians employing Chinese herbal medicine commonly prescribe the formula *Du Huo Ji Sheng Tang*, or its derivatives, particularly in small breeds. In Chinese medicine terms, this formula treats acute Wind invasion secondary to Kidney Deficiency, the pattern that was present in the dog in this report. The intent is to optimize circulation throughout the spinal column to restore suppleness and remove it as a potential source of ongoing circulatory impingement within the cord itself. Given the association of cord inflammation with increased NO levels, the use of the formula at first glance seems contraindicated, since some components of the formula actually increase NO activity in the spine, including loranthus (*Loranthus ferrugineus*), Chinese angelica (*Angelica gigas*), rehmannia (*Rehmannia glutinosa*),

and particularly eucommia (*Eucommia ulmoides*) (10-13). The key distinction, however, is that it is *endothelial* NO that is being increased, not neuronal NO. Some constituents of *Du Huo Ji Sheng Tang* do lower neuronal NO, including cinnamaldehydes from cinnamon (*Cinnamomum cassia)*, but it would seem more likely that it is the increase in endothelial NO that was operative in facilitating recovery in this case (14).

As discussed by Papalia et al, endothelial NO accumulation in the spine, such as is promoted by *Du Huo Ji Sheng Tang*, increases the quality of circulation to the borders of the avascular discs into which nutrients and oxygen then travel, thus helping to prevent their degeneration and calcification while helping to restore normal spinal mobility (15). This boosting of circulation through the spinal column is also implicit in the Chinese medical understanding of the formula's action. In Chinese medical parlance, the formula expels Wind Cold pathogens causing spinal rigidity and muscle spasticity by warming and hydrating the dorsum through the increased delivery to the spine of Qi, Blood, and Yang.

Declines in endothelial NO in tissues decrease their structural integrity, promoting apoptosis and chronic inflammation through a process known as endothelial dysfunction. Endothelial dysfunction occurs in a wide variety of tissues, including ligamentous connective tissues. Its role in osteoarthritis, cruciate ligament injury, and even human dental pathology has been demonstrated, making it plausible it could likewise cause degeneration and avascularity in the ligaments and annuli of the spinal column, predisposing a patient to spondylosis, disc degeneration, and rupture (16-18).

In the author's experience, the use of 'tonic' formulas like *Du Huo Ji Sheng Tang* that enhance CNS circulation usually causes an abrupt worsening of signs in acute CNS inflammation. That response was not seen here, bolstering the suspicions of the author that this patient most likely had IVDD, the working diagnosis in the management of the case. The chronicity of the lesion seemed to preclude a fibrocartilaginous embolism. There was no history of trauma that would explain the signs nor any enduring pain to suggest discospondylitis. The clinical progression seemed too abrupt for degenerative myelopathy, and no breed predisposition was present. Neoplasia was a possibility given the dog's age and the obstinacy of clinical signs and would have become more of a consideration if integrative therapy had not been successful. The onset of "spaciness" following the introduction of methocarbamol and its resolution immediately upon withdrawal suggests a disseminated CNS disorder was not present. A cause was not determined for the seizures that were observed only after a single NMES treatment by the caretaker. Although largely considered safe, some sources report pre-existing seizure disorders as a contraindication for NMES (19). Since the pet in this case was a rescue, a complete history was not accessible to rule out prior seizures or epilepsy. Nevertheless, without a full diagnostic workup, the deductive process of determining a definitive cause from this list of possibilities is impossible. The prompt improvement of this case in the absence of a definitive biomedical diagnosis demonstrates the utility of the inductive pattern-based approach that is central to Chinese medicine. Analysis of a successful treatment and how it works in Western medical terms can help infer, in hindsight, what the biomedical diagnosis may have been.

Due to financial constraints, initial treatment for the patient in this case was limited to relief of inflammation, pain, and muscle spasms. Although the dog had been assessed as grade 4 in severity with a working diagnosis of IVDD, surgery was impossible due to the lack of financial resources needed to confirm the diagnosis and to precisely locate the lesion. Unfortunately, medical management alone did not suffice to produce an acceptable level of improvement in mobility and micturition. Although steroids are commonly used in the first hours following spinal cord injury, studies have suggested that the use beyond that point may hinder spinal cord healing, possibly by inhibiting initiation of healing by ependymal glial cells. Their main use is in limiting inflammation and acute cord damage, making them less helpful once NO levels have subsided (20-22). Corticosteroids were used for about 2 weeks following diagnosis in this case.

The improvement in this dog was dramatic and rapid following the first acupuncture treatment, which was focused upon local points and veterinary chiropractic mobilization of the dog's spine, making it less likely in the author's opinion that disseminated inflammation of the CNS was causing seizures, altered mentation, and paresis, and more likely that a local cord impingement or physical obstruction to cord circulation existed that was relieved as soon as therapy was instituted. Although levels of NO and neuronal degeneration in this patient could not practically be determined, the rapid improvement suggests that degeneration was not pronounced. The very high NO phase that causes degeneration in acute ongoing CNS inflammation was likely not present, and any increase in NO had possibly subsided to levels associated with chronic inflammation. The impediment to resolution of cord injury responded favorably to focusing

treatment on the spinal column as the likely source of continued paralysis rather than other possibilities.

Although acupuncture and rehabilitation therapy are usually the first integrative approaches to be considered, veterinary chiropractic, herbal medicine, and diet change can also play important roles in improving patients with presumed disc disease. The rapid improvements in function attributed to the improved spinal column and cord circulation may have resulted not just from the *Du Huo Ji Sheng Tang* alone, but rather from the combined use of all the modalities applied in this case. Meta-analyses and high-level reviews have shown acupuncture to be one of the single most effective therapies in disc disease (23). Many potential reasons exist for this, but an improvement in blood flow through various target tissues with acupuncture has been repeatedly confirmed (24). The utility and safety of chiropractic in IVDD have likewise been amply demonstrated and may work through many different pathways (25). MRI studies show a reversal of disc protrusion in a majority of disc disease patients treated with chiropractic, making it reasonable to expect a resultant reduction of cord circulation impingement (26). It is reasonable to expect veterinary chiropractic to work similarly, given the pathophysiology of disc disease in dogs.

Regarding the impact of nutrition, studies in humans and dogs show the glycemic index of a particular diet is linked to its propensity to cause endothelial dysfunction (27, 28). The glycemic index is, in turn, linked to the degree of processing and carbohydrate content. This dog's diet was changed from processed kibble to a home-cooked whole foods meat-and-vegetable diet that contained only low amounts of carbohydrate. The lack of processing results in a meal that is much slower to digest, thus keeping the glycemic index low. Within just a few days, the caregiver noted resolution of chronic skin dander and ear tip flaking in this dog, suggesting an improvement in overall peripheral circulation and thus endothelial function. Since endothelial function is a systemic phenomenon, these improvements likely extended to all body tissues, including the spinal canal and column, providing a critical foundation for a full recovery.

Care of the connective tissues surrounding the spinal cord rarely receives focus in studies on how to promote recovery from a spinal injury. The utility of the integrative protocol used to treat this refractory case of paralysis suggests that normalizing circulation through the spinal cord and column should be investigated as a primary treatment focus once acute cord inflammation has subsided.

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Endnotes

a. Spec cPL®, IDEXX Reference Laboratories, Westbrook, ME, 04092

b. Activator II , Activator Methods International Ltd, Phoenix, AZ, 85034

c. Natural Path Herb Company Ltd, Edmonton, Alberta, Canada

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