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Comparison of Acupuncture and Electroacupuncture for the Treatment of Dogs with Thoracolumbar Intervertebral Disc Disease: a Randomized Controlled Trial

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Abstract

Intervertebral disc disease is a very common cause of neurological disorder in dogs, and it may result in back pain, paraparesis, or paraplegia. In recent decades, acupuncture is one of the treatments in dogs with intervertebral disc disease. Therefore, we want to conduct a randomized control trial to understand the therapeutic difference between acupuncture and electroacupuncture. 25 dogs with the signs less than 14 days were included. They were randomly allocated into acupuncture (A) and electroacupuncture (B). 10 acupoints were selected, including 4 acupoints of Hua-Tuo-Jia-Ji, GV 3 (Yao Yang Guan), lumbar Bai-hui, bilateral GB 30 (Huan Tiao) and BL 60 (Kun Lun). Functional numeric scale was used to measure the neurological function every week until finishing the study.

After a week of treatment for 16 dogs, their score of functional numeric scale significantly increased. The dogs that completed treatments recovered greatly, and the successful rate were 77% (7/9 dogs) and 100% (7/7 dogs) in group A and B respectively. The spontaneous resorption of herniated discs in spinal canal may be the mechanism why dogs could recover so fast with acupuncture and electroacupuncture treatments.

Keywords

Electroacupuncture; Dogs; Thoracolumbar Intervertebral disc disease; Acupuncture

Introduction

Thoracolumbar spinal cord diseases of dogs may result in back pain, paraparesis, or paraplegia. There are 2 patterns in the etiology of this disease, including structural compression and non-structural compression. Intervertebral disc disease (IVDD), vertebral dislocation, spondylosis and tumor would cause structural compression. While degenerative changes, fibrocartilaginous embolism and infection would lead to non-structural compression [1,2].

Thoracolumbar IVDD is a very common cause of neurological disorder in dogs [3,4] and the incidence rates were 34.92% in dachshunds, 27.06% in French bulldog, and 20.59% in Pekingese [5]. There are 2 types of IVDD: Hansen type I and Hansen type II disc diseases. Hansen type I disc diseases refer to extrusion of the nucleus pulposus, and Hansen type II disc diseases refer to protrusion of the annulus fibrosus [6,7].

In anatomy of dogs, about 16% of the vertebral column length is intervertebral discs in the thoracic and lumbar regions [8,9]. The intervertebral disc spaces in cervical and lumbar regions are wider than the caudal thoracic spaces [9,10]. The narrower difference in the length of intervertebral discs may be the reason why IVDD is more common over thoracolumbar region than other part of spine in veterinary clinics.

According to the onset of clinical signs, IVDD could be classified as peracute type, acute type and chronic type. Onset of signs less than an hour is peracute type, between 1 to 24 hours is acute type, and more than 24 hours is chronic type [6,11].

There are 2 major types of treatments in IVDD of dogs: conservative therapies and surgical treatments. Conservative therapies are non-invasive, including medication, rehabilitation, confinement, acupuncture and electroacupuncture [1,12,13]. Surgical treatments are more invasive, such as decompression with removal of extruded disc material [6,14]. According to the severity and onset of the disease, general body condition of the dog, and economic considerations of the owners, veterinarians would make recommendations of treatment protocol for the dog [1,12,13].

Though most of dogs with IVDD could recover ambulation after surgical managements [15], performing surgery over 48 hours after the onset of IVDD would reduce the success rate greatly [16-18], so it would be better to apply conservative therapies in chronic type of IVDD, such as using acupuncture or electroacupuncture. There are several studies demonstrated satisfactory therapeutic effects of acupuncture and electroacupuncture treatment in dogs with IVDD [2,4,16]. However, there is no any prospective randomized control trial to compare

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the effect of acupuncture and electroacupuncture in dogs with IVDD. Therefore, the aim of this study is to find out whether there is any therapeutic difference between acupuncture and electroacupuncture for treatment of thoracolumbar IVDD in dogs.

Materials and Methods

Dogs with the signs of thoracolumbar IVDD less than 2 weeks were included in this study. Physical, neurological, and radiographic examinations were performed to rule out the combination of vertebral tumor, vertebral fracture or spinal dislocation. This study was conceived according to the principles of the 3Rs and approved by the Institutional Animal Care and Use Committees of National Yang-Ming University (IACUC Approval No. 1051209). All owners signed an informed consent before treatment.

All dogs were injected with single dose of methylprednisolone (Zoetis, Kalamazoo, MI, USA) 2mg/kg IM at the first time of assessment. Chinese herbal medicine, NSAID and other drugs were not used during the period of study.

Dogs were randomly allocated into acupuncture group (group A) and electroacupuncture group (group B). In both groups, 10 acupoints were selected, including 4 acupoints of Hua-Tuo-Jia-Ji, GV 3 (Yao Yang Guan), lumbar Bai-hui, bilateral GB 30 (Huan Tiao) and BL 60 (Kun Lun) (Figure 1). In group A, the needles were inserted and remain for 10 minutes; but in group B, the same 10 acupoints were connected with an electrostimulator (Ching Ming TENS Model-05B; Ching Ming, Taiwan). We lined 2 acupoints of Hua-Tuo-Jia-Ji at the same side, GV 3 to lumbar Bai-hui, and GB 30 to BL 60, with 1mA at a frequency of 20 Hz (dense disperse wave) for 10 minutes. Both groups were treated twice per week for 6 weeks at most for each dog in the study. The treatment could finish early when the dog recovers with no any neurological dysfunction.

The severity of neurologic signs in IVDD could be classified as grade 1 to 5: grade 1, pain associated with IVDD; grade 2, ambulatory paraparesis with or without pain; grade 3, non-ambulatory paraparesis; grade 4, non-ambulatory paraplegia with deep pain; grade 5, non-ambulatory paraplegia without deep pain [16]. The grade of each dog was recorded at the first time of neurological examination.

Functional numeric scale (FNS) was used to measure the neurological function every week until finish the study. The score was recorded by assessment of the ability to stand up, movement of pelvic limbs, deep pain perception, urinary control, ability to walk and movement of the tail (Table 1) [4]. Successful treatment was considered to make the dogs get score 23 in FNS, which means no any neurological dysfunction. The recovery time was defined as the days from onset of IVDD to get score 23 in FNS (Table 1). We finished the study of a dog when it get score 23 in FNS, and recorded the recovery time.

SPSS (SPSS, version 22.0, IBM Corp., New York, NY, USA): Independent Sample T-tests was used to analyze the data between groups. Paired Sample T-tests was used to analyze the data before and after the treatment in the same groups. Values of $p < 0.05$ were considered significant.

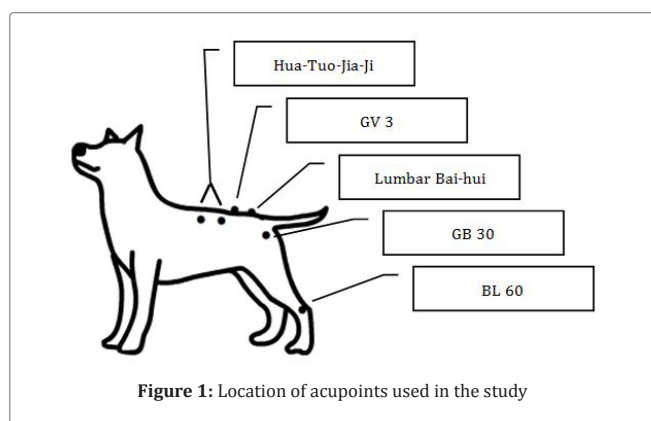


Figure 1: Location of acupoints used in the study

Results

25 dogs were included in this study from April 2017 to March 2018. The breeds included were Dachshund (n=18), toy Poodle (n=3), Pug (n=2), French bulldog (n=1), and Maltese (n=1). Among the 25 dogs in this study, 6 dogs in each of the grade 1 to 4, and 1 dog was classified as grade 5.

9 dogs in group A and 7 dogs in group B completed the research. Their average body weight was 7.4 ± 2.9 kg (range, 3.0–13.9 kg), and average age was 6.4 ± 1.8 years (range, 4–10 years). In group A, including 5 Dachshunds, 1 Pug, 2 Poodle, and 1 Maltese. 2 dogs had dysfunction grade 1, 3 had grade 2, 3 had grade 3, and 1 had grade 4. In group B, including 4 Dachshunds, 1 Pug, 1 Poodle, and 1 French Bull dog. 2 dogs had dysfunction grade 1, 3 had grade 2, 1 had grade 3, and 1 had grade 4.

There was no significant statistical differences in age, weight, onset time of IVDD and FNS score before treatment between group A and B ($p > 0.05$) (Table 2), which means it was a random allocation. The median FNS score before treatment of 16 dogs with dysfunction grade 1 to 4 in this study is 21, 20, 13.5, 6, respectively.

There were 2 dogs got FNS score 20 and 21 respectively after 12 session of acupuncture treatments in 6 weeks, so the recovery time of them was defined as 42 days when its best FNS were noted.

There were 2 dogs still had ataxia gait after 12 session of acupuncture treatments in 6 weeks, so the successful rate were 77% (7/9 dogs) in group A. In group B, 100% (7/7 dogs) recovered without any neurological dysfunction within 4 weeks by electroacupuncture treatment. The recovery time of group A and B demonstrate that electroacupuncture treatments was significantly faster and more effective ($p < 0.05$) than acupuncture treatments (Table 3).

In different time point, the mean FNS score of group B were higher than group A, which also shows a trend that electroacupuncture was more effective than acupuncture (Table 4).

FNS score significantly increased in the 16 dogs that completed the study. It shows that both of acupuncture and electroacupuncture could improve neurological function after one and two weeks of treatment ($p < 0.05$) (Table 5).

Discussion

We included 25 dogs, but 9 dogs dropped-out from this study. The main reason why they didn't finish the study was owners could not make their dogs recheck on time, and 3 dogs were did euthanasia after only 1 or 2 session of acupuncture or electroacupuncture. The neurological dysfunction due to IVDD is usually not improving in a short time by acupuncture or electroacupuncture, especially when the grade is high. Therefore, some owners would give up the treatments and did euthanasia for their dogs based on humanitarian and compassionate considerations to relieve suffering.

If we could include more dogs with IVDD in grade 1 to 5, we could compare the effectiveness of acupuncture and electroacupuncture in low and high grade respectively. However, only 16 dogs completed the treatments in this study, so we could not divide the dogs into high grade or low grade group to compare the differences in recovery time and successful rate of acupuncture and electroacupuncture.

In this study, 10 dogs were classified as dysfunction grade 1 and 2, which was considered to be low grade group. And 6 dogs were classified as grade 3 and 4, which was considered to be high grade group. The recovery time (Mean $\pm$ SD) was 11.0 ± 6.78 days (range, 5 to 23 days) and 30.2 ± 12.80 days (range, 10 to 42 days) in low and high grade groups respectively. It shows that dogs with grade 1 and 2 could recover in a significantly ($p < 0.05$) shorter time than those with grade 3 and 4, and the successful rate were 100% (10/10 dogs) and 67% (4/6 dogs) in low and high grade groups respectively.

Though it is controversial to do acupuncture or electroacupuncture in combination with conventional medicine such as NSAIDs and SAIDs, some researchers indicated that combining corticosteroid with electroacupuncture was more effective and shorter in recovery time than using it alone respectively [4,19,20]. Based on

Neurological function	Scale
Ability to stand	0 = Cannot stand even with assistance
	1 = Can stand and maintain standing, with assistance
	2 = Can stand and maintain standing, with assistance, and stand alone for 2 s
	3 = Can stand and maintain standing, with assistance, and stand alone for 2 s
	4 = Can stand without assistance
Movement of pelvic limbs	0 = Lack of movement
	1 = Movement of 1 pelvic limb and nonambulatory
	2 = Movement of both pelvic limbs and nonambulatory
	3 = Movement of both pelvic limbs and ambulatory, with weight bearing on 1 or both limbs without assistance, with ataxia
	4 = Movement of both pelvic limbs and ambulatory, with normal weight bearing and without falling
Deep pain perception	0 = Lack of deep pain perception
	1 = Questionable deep pain perception and need to search in several digits or tail, detectable in 1 of the structures with doubtful response to stimuli
	2 = Isolated deep pain perception in 1 digit or tail and dog looks toward stimulated structure but does not vocalize
	3 = Deep pain perception, and dog appears to be more uncomfortable when stimulus applied
	4 = Unquestionable deep pain perception
Urinary control	0 = Lack of urinary control (constant urinary retention or incontinence)
	1 = Almost constant urinary retention or incontinence
	2 = Urinary retention or incontinence is intermittent or occurs when the dog is manipulated; manual expression of bladder is required.
	3 = Intermittent urinary control and lack of incontinence
	4 = Complete urinary control
Ability to walk	0 = Lack of motor function or ambulation
	1 = Ambulation only if dog supported in the abdominal or inguinal region
	2 = Ambulation without support, with intermittent ataxia
	3 = Ambulation without support, with rare ataxia or ataxia only over smooth or slippery ground
	4 = Normal ambulation
Movement of the tail	0 = Lack of voluntary tail movement
	1 = Nonvoluntary tail movement
	2 = Intermittent voluntary tail movement
	3 = Normal tail movement

Table 1: Criteria for scores in an FNS used for evaluation of neurologic function in dogs. Used with permission from Hayashi [4]

Signalment	Group A (n=9)	Group B (n=7)	p-value
Age (year)	6.8 ± 1.83 (5-10)	5.8 ± 1.57 (4-8)	0.255
Weight (kg)	7.4 ± 3.13 (3.0-13.9)	7.2 ± 2.78 (5.1-12.6)	0.883
Onset of IVDD (days)	2.8 ± 1.27 (1-5)	5.2 ± 4.39 (1-12)	0.138
FNS score before treatment	16.4 ± 5.03 (8-21)	17.2 ± 6.21 (4-21)	0.768

Table 2: Signalment of dogs that completed the study in 2 groups

	Group A (n=9)	Group B (n=7)	p-value
Successful rate	77% (7/9 dogs)	100% (7/7 dogs)	0.169
Recovery time (day)	23.6 ± 14.77 (5-42)	11.3 ± 6.75 (6-21)	0.047*

*p<0.05. The recovery time was significantly shorter in group B than group A

Table 3: The successful rate and recovery time of group A and B

Time point (week)	FNS score (Mean $\pm$ SD) and range	
	Group A (n=9)	Group B (n=7)
1	18.88 $\pm$ 3.76 (14-23)	21.71 $\pm$ 1.89 (18-23)
2	20.88 $\pm$ 2.57 (16-23)	22.57 $\pm$ 0.79 (21-23)
3	21.14 $\pm$ 2.04 (18-23)	23.00 $\pm$ 0 (23)
4	21.20 $\pm$ 2.05 (19-23)	23.00 $\pm$ 0 (23)
5	21.25 $\pm$ 2.06 (19-23)	*
6	21.33 $\pm$ 1.53 (20-23)	*

*in group B, all dogs recovered within 4 weeks and finished the treatment, so FNS score was not recorded

Table 4: FNS score in group A and B at different time point

Time point (week)	FNS score (Mean $\pm$ SD and range, n=16)	Paired t test <i>p</i> - value
Before treatment	16.8 $\pm$ 5.4 (4-21)	-
1	20.1 $\pm$ 3.3 (13-23)	0.001*
2	21.6 $\pm$ 2.1 (16-23)	0.000*

**p*<0.05. Acupuncture and electroacupuncture significantly improved neurological function

Table 5: FNS score of 16 dogs that completed the study at different time point

experiences and previous study, methylprednisolone was one of the most suitable conventional medicines for dogs with thoracolumbar IVDD [20]. In order to minimize the adverse effects and avoid bias caused by conventional medicine, we only used a single dose of methylprednisolone at the first time of assessment in every dog in this study.

The results demonstrate that both acupuncture and electroacupuncture were effective treatment for dogs with thoracolumbar IVDD, and electroacupuncture provided a better prognosis than acupuncture treatment. One of the possible effect making differences of efficacy exist is that electroacupuncture activating the spinal cord to release more β -endorphins into the cerebrospinal fluid [21]. Though the mechanism of recovery from thoracolumbar IVDD by acupuncture and electroacupuncture is unclear, the newly formed vessels, increasing blood circulation, growth factors, inflammatory cells and their products may play an important role [19,22].

Previous studies show that acupuncture significantly raised the number of basic fibroblast growth factor (bFGF) positive neurons [23], which is well known as an angiogenesis stimulation factor *in vivo* and facilitating the resorption of the herniated intervertebral disc [24]. Spontaneous disappearance of herniated discs in the spinal canal could also be a possible mechanism for recovery without spinal decompression surgery [25], and herniated material was likely resorbed actively during the acute phase [26]. Therefore, we included dogs had onset of IVDD within 2 weeks, avoiding delays in treatment procedures, making an effort to get a better prognosis.

In summary, both acupuncture and electroacupuncture were effective treatments for thoracolumbar IVDD of dogs, and dogs treated by electroacupuncture were shorter in recovery time than acupuncture. Besides the spinal cord decompressive surgery, electroacupuncture is also a proper treatment, especially for dogs that have high anesthesia risk or owners who have financial considerations. Completing the sessions of electroacupuncture with patience, most dogs could relieve pain, recover neurological function and regain walking ability gradually in few weeks. However, further studies are needed in the future to investigate mechanisms of acupuncture and electroacupuncture treatment in dogs with thoracolumbar IVDD.

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