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The Official Journal of the American Association of Traditional Chinese Veterinary Medicine, the American Academy of Veterinary Acupuncture, the International Veterinary Acupuncture Society and the World Association of Traditional Chinese Veterinary Medicine

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About the Cover

In 2021 the covers of AJTCVM boast the color red to honor the Fire Element.

Chinese Stamp depicting scene from "Romance of the Three Kingdoms"

In honor of the Fire Element for the August issue, the cover depicts a fiery scene from the historical novel *Romance of the Three Kingdoms* written in the 14th century by Luo Guanzhong. The novel is based on the historical chronicle, *Records of the Three Kingdoms*, written by Chen Shou and begins in the final years of the Eastern *Han* Dynasty (around 169 AD), when the government becomes increasingly corrupt on all levels. The *Han* Empire was disintegrating into civil war as warlords fought for territories and power resulting in the formation of three regions: *Wei* (north of the Yangtze), *Shu* (southwest) and *Wu* (southeast). The novel deals with the plots, military battles, intrigues, personal weakness/emotions and struggles of these states to achieve dominance for almost 100 years and ends with the reunification of the land in 280 by establishment of the *Jin* Dynasty. The scene on the stamp issued by China in 1990 depicts Cao Cao, leader of the kingdom of *Wei*, leading a clever surprise night attack on the food depot in Wuchao (199 AD) of rival warlord, Yuan Shao. The burning of food supplies allowed Cao Cao's smaller number of men to best a much larger army and set him on the path to unify most of northern China under his control. The novel deals with the cyclical history of dynastic decline and the breakdown of order. Its complexity of stories and characters with numerous subplots is masterful with nearly a 1000 dramatic characters and 800,000 words over 120 chapters. *Romance of the Three Kingdoms* is acclaimed as one of the four great classical novels of Chinese literature and is one of the most widely read historical novels in late imperial and modern China.

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Clinical Studies

A Randomized, Blinded and Controlled Study Using Digital Thermal Imaging to Measure Temperature Change Associated with Acupuncture in Dogs with Back Pain

Patricia J. Collins DVM, MS-TCVM

ABSTRACT

Digital thermal imaging provides an objective and measurable evaluation of the changes in radiant energy emitted by the body. This study sought to determine the effects of acupuncture immediately after back pain treatment in dogs through digital thermal imaging. Dogs ≥ 6 months exhibiting clinical symptoms of back pain with pain scale 1 or 2 (0-4 scale) were recruited for the study. Subjects (n=24) were randomly assigned to the Acupuncture Group (n=12) which received dry needle acupuncture at GV-14, BL-23 bilateral, *Bai-hui* and *Shen-shu* for 15 minutes or the Control Group (n=12) which was not treated but waited 15 minutes. Digital thermal images were obtained before and after the acupuncture treatment (Acupuncture Group) or the waiting period (Control Group) by a person blinded to the group assignments. Maximal temperature was recorded within the affected surface area and absolute change of temperature was compared between study groups. Group comparison of subject signalment data, baseline pain score, and baseline (pre-treatment) temperature (all p-values > 0.05) suggested group comparability for the study. The mean±SD temperature change in the Acupuncture Group was 1.60±0.51°F, and in the Control group was 0.44±0.26°F. The overall temperature change difference between the two subject groups was statistically significant ($p = 2.96\times10^{-6}$). The results from this study indicate that local acupuncture treatment at a site of pain can lead to temperature changes in the location which may have effects on pain reduction. Future studies to investigate the association of acupuncture created temperature change and pain mitigation are warranted.

Keywords: acupuncture, digital thermal imaging, dogs, back pain

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ABBREVIATIONS

EAP	Electro-acupuncture
DNAP	Dry needle acupuncture
IVDD	Intervertebral disc disease
TCVM	Traditional Chinese veterinary medicine

Pain is a subjective sensation that should be assessed by the individual, but dogs cannot provide this information verbally. Evaluation of chronic pain in dogs, therefore, is left to nonverbal observations such as gait abnormalities, behavior or attitude changes, radiographs and plasma hormone assays.[1] Each of these can be helpful distinguishing differences in pain levels of dogs but are not consistent due to individual variation. To complicate things further, dogs also exhibit breed specific and training related differences in their response to pain.[2]

A study conducted by Hielm-Bjorkman demonstrated that chronic pain can be assessed better by thoughtful completion of a well-designed questionnaire by a pet owner than by reviewing radiographs or hormone assays alone.[1] Recognition of pain in dogs, therefore, can start with the patient's history and asking leading questions regarding subtle behavior patterns.[3] Owner questionnaires can be detailed and may include: appetite, mood, interaction with family members, tail wagging, pacing, willingness to play/walk, ease of laying down/rising, negotiating stairs, excessive panting, lip licking, vocalization, aggression and different reactions to being touched. Even though subjective, the behavior assessment can then have a numeric pain scale assigned to questionnaire interpretation which improves standardization of the evaluation. The physical exam collects objective data such as temperature, heart rate, respiratory rate, pupil dilation, painful/tense areas and blood pressure but even these parameters are subject to variable dog responses to hospital or clinic environment.

From: Valley Cottage Animal Hospital, Valley Cottage, NY, USA

Author Professional Certifications: CVA, CVCH, CVFT, CVTP

It is also important to note that, while palpating painful areas, some dogs can be stoic which confounds pain recognition.

Today's digital thermal imaging innovations provide veterinarians with an efficient tool to monitor body function and injuries. Digital thermal imaging provides an objective and measurable evaluation of a patient's physiological state by documenting the surface temperature of the individual. Disease processes and tissue injury show different temperatures due to a change in blood flow. The metabolic heat from an animal is directly related to blood circulation. Increases in the body surface temperature are a result of increased blood flow due to inflammation, increased use or a result of injury, whereas decreases in body surface temperatures are a result of reduced blood flow due to nerve damage, atrophy, scarring, thrombosis or infarction.[4]

A study by Tunley and Henson showed that thermographic patterns are reproducible and topographical thermographic maps can be compared to pathological cases.[5] The technique has also been shown to be useful for the diagnosis of cranial cruciate ligament disease in dogs without stifle laxity.[6] Another study found thermal imaging to be a useful tool to diagnose pain in cats, which can be difficult and often goes undetected.[7] The study, with a total of 103 cats, demonstrated that palpation of painful conditions and thermographic imaging correlated relatively well. The agreement between the owner's assessment of pain and thermographic imaging was low; however the agreement between palpation and thermographic imaging was moderate, making thermographic imaging a potential tool in clinical practice for screening cats for pain.

Acupuncture is an effective, safe, and minimally invasive treatment for acute and chronic pain control in companion animals which is steadily gaining popularity among veterinarians and pet owners.[8] In traditional Chinese veterinary medicine (TCVM), *Qi* flow, or the flow of vital energy is the essence of health. When this *Qi* flow is obstructed, pain results. Acupuncture provides pain relief by restoring *Qi* and Blood flow thereby reducing painful Stagnation. Functional magnetic resonance imaging (MRI) studies investigating a conventional mechanism of action for pain relief associated with acupuncture treatment have shown that stimulation of acupuncture points results in specific changes in the central nervous system such as the release of endogenous opioids.[9,10] This is further supported by a study in equine colic which demonstrated that dry needle (DNAP) acupuncture and electroacupuncture (EAP) was associated with endorphin release which relieved clinical symptoms in affected horses.[11]

The objective of this study was to measure thoracolumbar sacral skin temperature change associated with acupuncture treatment of canine back pain using digital thermal imaging. The hypothesis was that dogs treated with dry needle acupuncture would have greater back temperature change than the untreated controls.

MATERIALS AND METHODS

The study candidate population consisted of dogs exhibiting clinical signs of back pain. The presence of back pain was determined by a history of reluctance to exercise, stiffness, abnormal gait and/or pain exhibited during physical examination. In addition, some study subjects had previous radiographs showing spondylosis or narrowed disk spaces. The back pain of each individual study subject was graded according to the canine pain scale from 0-4, as classified by the Colorado State University Veterinary Medical Center (Table 1).[12] Dogs were recruited from the hospital population of client and staff owned dogs of the Valley Cottage Animal Hospital in Valley Cottage, New York, USA. Inclusion criteria were dogs (1) 6 months or older; (2) symptoms of mild back pain (pain score 1 or 2, scoring = 0 to 4) due to arthritis, disk disease, trauma or sports injuries; and (3) informed consent for study participation provided by owner. Subjects with any known cancer or infectious disease were excluded from the study.

A subject's baseline pain condition was considered a likely confounder to study outcome, therefore, to have good comparability between groups; a baseline pain score (grade 1 or 2 required) for each potential subject was assessed during the physical exam before the study. Qualified dogs were randomly assigned to one of two treatment groups: the Acupuncture Group or Control Group. The randomization assignment was conducted through an online tool[a] using the block randomization method that would ensure equal sample sizes between study groups. For each subject in the Acupuncture Group,

Table 1: Canine pain scale used to grade severity of back pain in study dogs.[12]

Score	Conditions
0	Comfortable, happy and content
1	Content, but slightly unsettled with mild body tension
2	Uncomfortable with mild to moderate body tension
3	Unsettled, crying and guarding/flinching upon palpation
4	Constantly groaning/crying with moderate to severe body tension and extreme resistance to being touched

a baseline digital thermal image[b] of the dog's back was obtained (Figure 1). The subject then received a dry needle acupuncture treatment (performed by author, certified in veterinary acupuncture) at GV-14, BL-23 (bilateral), *Bai-hui* and *Shen-shu* (bilateral). The needles (0.22×25 mm)[c] were left in place without any further stimulation for 15 minutes, while the patient was allowed to move freely in a 10 by 12-foot exam room. Any needles that fell out were not replaced. After the 15 minute acupuncture treatment, the needles were removed and a second digital thermal image of the back was obtained. The dogs in the Control Group also underwent baseline digital thermal imaging of the back, waited for 15 minutes in the same exam room and then had a second digital thermal image obtained. All digital thermal imaging was performed by an investigator blinded to the group assignments.

To ensure consistency of thermal camera imaging, study dogs had limited exercise and were not bathed or otherwise submerged in water for a 24 hour period prior to treatment. All thermal images were taken in a room with a temperature range of 68 - 74°F and dogs were only minimally handled by trained technicians. In addition, the areas of the dogs' body to be analyzed were not touched, so instead of using black cloth gloves, the technicians were able to use the more hygienic one time use rubber gloves.

The anatomic region of the back to be imaged was defined as mid-thoracic to base of tail area. Two digital thermal images pre- and post-treatment were obtained per study participant. From each image, the average temperature recorded within the selected surface area was used as the numerical data from each thermal temperature assessment (rectangle in image, Figure 1). The outcome measurement for each subject was the change of average temperature on the back from baseline to the time when the second thermal image was taken. The absolute value of the temperature change (increase or decrease) was used for group comparison since based on TCVM theory, an acupuncture treatment could modulate the body temperature at an injury site in either direction depending on the underlying cause of pain.

The study hypothesized dogs with symptoms of back pain who received a dry needle acupuncture treatment at protocol stipulated acupuncture points would have greater temperature change on the back compared to those who did not receive treatment. Without assuming a normal distribution of the temperature change data, two-sided nonparametric Wilcoxon rank sum test was used to test the hypothesis. The null hypothesis was rejected when the resulting *p*-value was less than 0.05. A study enrollment goal of 24 dogs with a sample size of 12 subjects in each group was sought to ensure that the applied Wilcoxon rank sum test had approximately 91% power to reject the null hypothesis with a significance level of 0.05. These parameters could be assumed under the condition that the probability that a subject in the Acupuncture Group has a larger temperature change than a subject in the Control Group was 85%. A commercial statistical software was used for all data graphic presentations and statistical analysis[d].

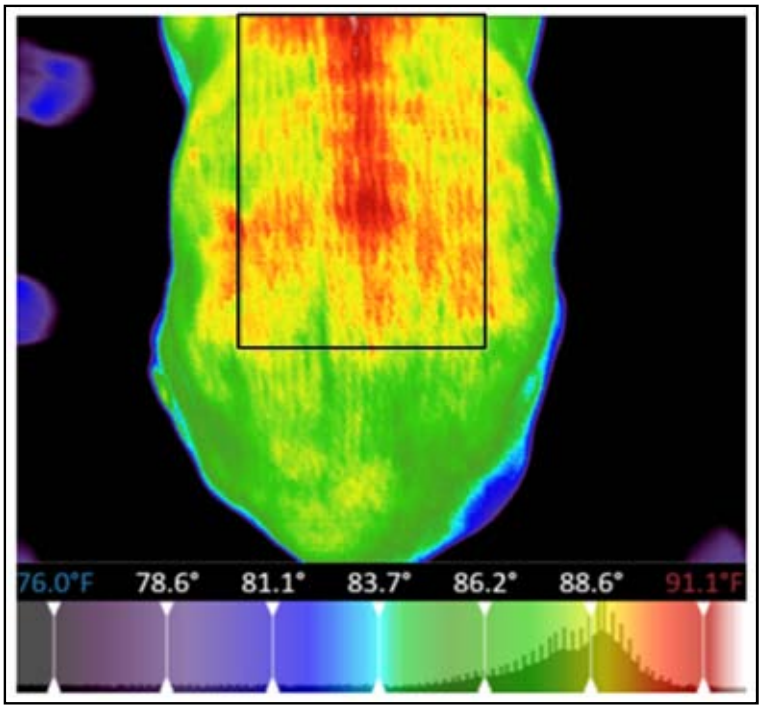

Figure 1: An example of a digital thermal image on a dog's back. The average temperature within the rectangle is the absolute temperature used for comparison between pre- and post-treatment values.

RESULTS

A total of 24 dogs exhibiting mild back pain (1 or 2 pain score) were enrolled and completed the study. Randomization resulted in 12 subjects in the Acupuncture Group and the remaining in the Control Group. In the acupuncture as well as the control groups, there were a total of 10 different breeds (Table 2). The diversity of breeds due to randomization of dogs within each treatment group reduced the possibility that the study outcome could be affected by a subject's breed.

The mean±SD age of subjects in the Acupuncture Group (11.2±3.4 years) were older than those in the Control Group (9.2±2.5 years) (Table 3). The group difference in age, however, was not statistically significant (p = 0.079; Wilcoxon rank sum test) between the two groups. The mean±SD weight among subjects in the Acupuncture Group was 44.3±34.7 pounds and was 46.5±32.9 pounds among those in the Control Group. Similarly, the weight difference between the two groups was not statistically significant (p = 0.932, Wilcoxon rank sum test). The distribution of sex in the Acupuncture Group was 50% (6/12) female vs. 50% (6/12) male. In the Control Group, 66.7% (8/12) were female and 33.3% (4/12) were male. The proportions of male or female was not significantly greater than 0.5 [p = 1.00 (acupuncture) and 0.39 (control), exact binomial test]. Between the two treatment groups, the proportions of female (or male) were not significantly different (p = 0.680, Fisher's exact test).

All subjects had pain scores of either 1 or 2. Half of the subjects (6/12 = 50%) in the Acupuncture Group had pain score 1 and the remaining half had score 2. In the Control Group, 75% (9/12) of the subjects had pain score 1 and the remaining 25% had score 2. Between the two subject groups, the proportions of subjects with pain score 1 (or 2) were not significantly different (p = 0.400, Fisher's exact test), despite a 25% difference (Figure 2).

Table 2: Breed incidences occurring in each study group. The diversity of breeds, due to randomization within each study group, reduced the possibility that the study outcome could be affected by a subject's breed.

Breed	Control Group	Acupuncture Group
Golden Retriever mix	0	1
Miniature Poodle	0	1
Wirehair Dachshund	0	1
Cavalier King Charles Spaniel	1	1
German Shepherd	2	1
Miniature Dachshund	0	1
Havanese	1	1
Dachshund	0	2
Brittany mix	0	1
Labrador Retriever	1	2
Boxer mix	1	0
Chihuahua	1	0
Standard Poodle	1	0
Greyhound	2	0
Maltese	1	0
Brittany	1	0

Table 3: Summary table of study dog age, body weight and gender for the Control Group and Acupuncture Group. The study groups were comparable with no statistically significant differences in subject population.

	Control group (n = 12)	Acupuncture group (n = 12)	p-value
Age (mean±SD, years)	9.2±2.5	11.2±3.4	0.079
Weight (mean±SD, lbs)	46.5±32.9	44.3±34.7	0.932
Sex (Female %)	66.7%	50.0%	0.680

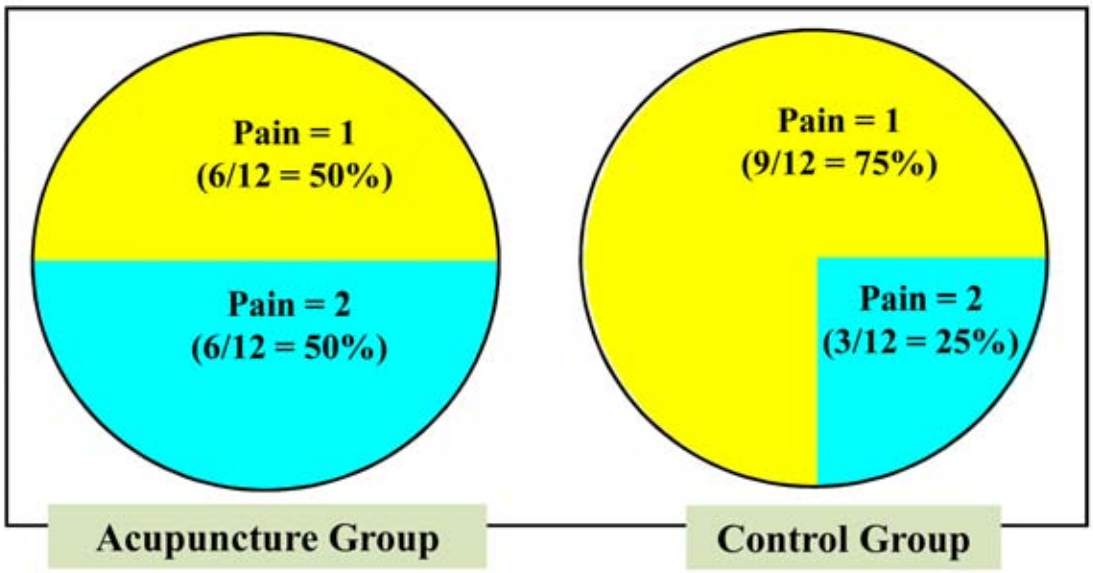

Figure 2: Distribution of pain score for study dogs before receiving study assigned treatment in each subject group (untreated control and acupuncture treatment). The groups were comparable with no statistically significant difference (p=0.400) in study population.

Thermal images were taken for each subject before and after the treatment period (Figures 3 and 4). The group mean±SD of the average temperature from the pre-treatment thermal imaging in the Acupuncture Group was 86.89±4.65°F, and in the Control Group was 86.15±3.92°F (Figure 5). The baseline temperatures were comparable between the two subject groups (p = 0.843, no statistical significance, Wilcoxon rank sum test). Post treatment digital image temperature change was calculated as the absolute value of the difference between baseline and the post-treatment temperatures (Figure 6). Among the 12 subjects receiving acupuncture treatment, 9 subjects (75%) had reduced temperature and the remaining 3 (25%) had increased temperature. In the Control Group, 8 subjects (66.7%) had reduced temperature and the remaining 4 (33.3%) had increased temperature (Figure 7). The mean±SD temperature change in the Acupuncture Group was 1.60±0.51°F, and in the Control Group was 0.44±0.26°F. The overall temperature change difference between the two subject groups was statistically significant ($p = 2.96\times10^{-6}$, Wilcoxon rank sum test).

DISCUSSION

This is the first known randomized, blinded and controlled veterinary clinical trial to show the effects of acupuncture in a naturally occurring disease with digital thermal imaging. The study objective was to measure thoracolumbar sacral skin temperature change associated with acupuncture treatment of canine back pain. A total of 24 dogs divided into untreated controls (n=12) and DNAP treated (n=12) had pre- and post-treatment digital thermal images. Temperature change was calculated as the absolute value of difference between baseline and post-treatment temperatures. The mean±SD temperature change in the Acupuncture Group was 1.60±0.51°F versus Control Group at 0.44±0.26°F (4X greater change for acupuncture). The overall temperature change difference between the two subject groups was statistically significant ($p = 2.96\times10^{-6}$). The results of the study supported the hypothesis, based on TCVM theory, that dogs treated with dry needle acupuncture would have greater back temperature change than the untreated controls under the experimental conditions of this study.

In this study, digital thermal imaging showed very clear differences between temperatures before and after acupuncture treatment, whereas, the Control Group had little temperature change. This suggests that acupuncture has a measurable effect on the radiated temperatures of the study subjects' bodies. It has been hypothesized that acupuncture derives its effects through increased production of endorphins and other neurotransmitters that influence pain sensation as well as other involuntary bodily functions.[13] It also stimulates vascular and immunomodulatory factors.[14] The beneficial effects, therefore, not only are associated with analgesia secondary to endorphin release, but also related to local vasodilation and anti-inflammatory effects.[15]

A characteristic of acupoint stimulation is that of dual effects. Stimulation of an acupuncture point can either inhibit excessive reactions or amplify deficient functions in the same target organ.[16] For example, acupuncture needle insertion at an acupuncture point stimulates the nervous system which alters blood flow and humeral responses such that inflammation with heat is decreased while stimulation at the same acupoint in an

area that lacks perfusion will stimulate blood flow creating a temperature increase. In this way acupuncture harmonizes the biological constants of the body. Considering this, treated subjects have radiant temperature changes represented, at least partially, by changes in blood perfusion. Similar to findings in this study, other studies have demonstrated acupuncture associated local changes in circulation and anti-inflammatory effects.[17-20] Acupuncture, therefore, starts as a local event of stimulation but then ripples through the nervous system of the body through multiple mechanisms.[21]

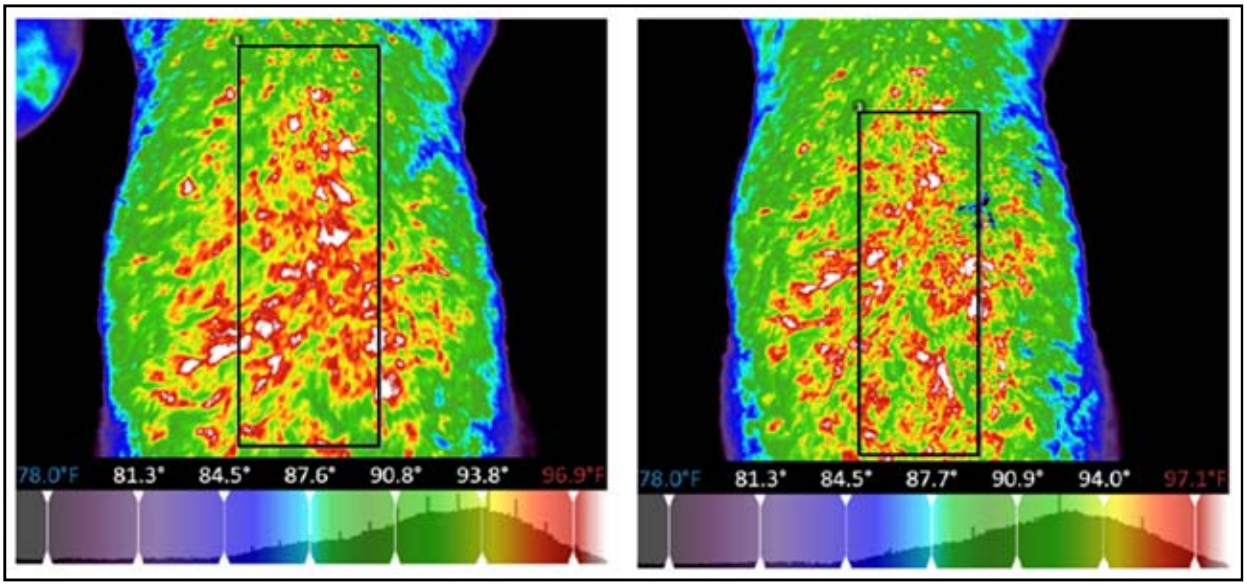

Figure 3: Thermal images on the back of a subject in the Control Group taken during the baseline period (left) and the post-treatment time (right). It is visually clear that the two images from the untreated control subject have similar color distributions. The average temperature within the focus area (rectangle) calculated by the device was 93.4°F in the baseline image and slightly increased to 93.6°F in the second image.

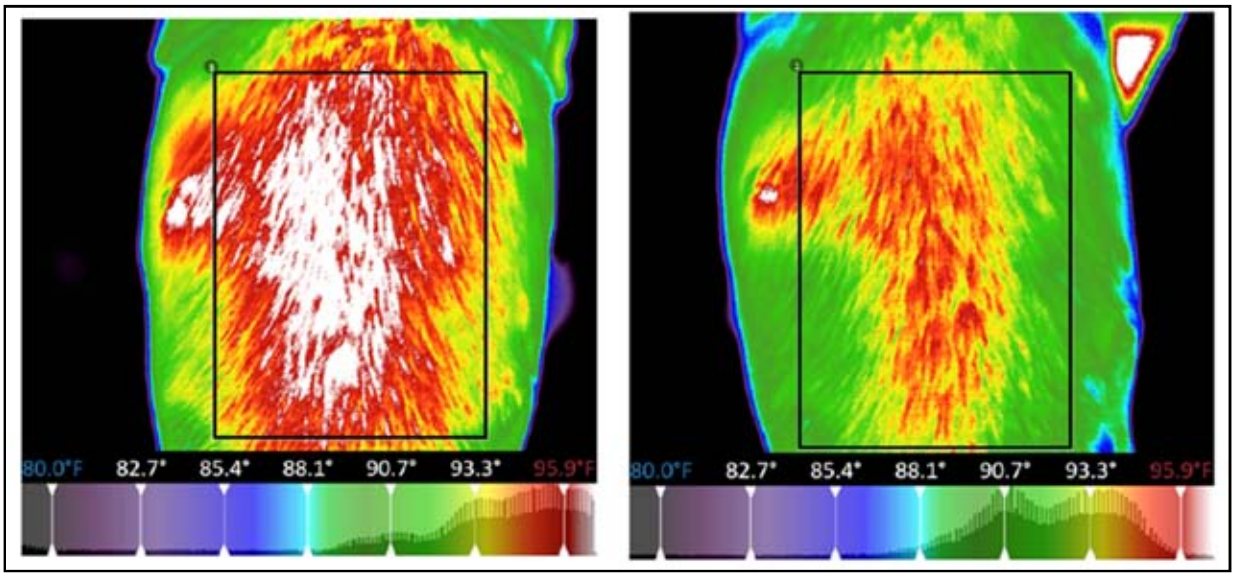

Figure 4: Thermal images on the back of a subject in the Acupuncture Group taken during the baseline period (left) and the post-treatment time (right). A significant difference in color distributions (rectangle) can be seen between the two images (94.8°F in the baseline image and reduced to 92.5°F in the post-treatment image).

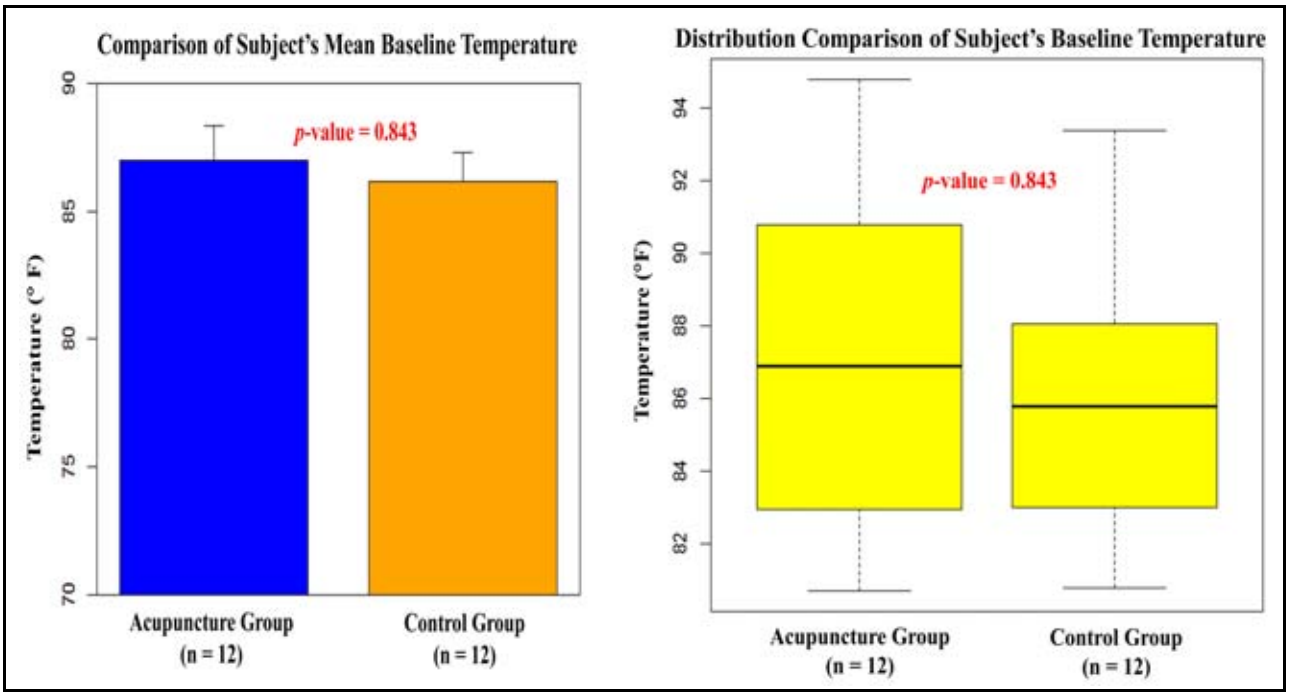

Figure 5: Pre-treatment average temperature mean and distribution of each study group; groups have similar baseline temperatures (86.89±4.65°F acupuncture vs 86.15±3.92°F controls).

Digital thermal imaging has been used in humans to evaluate the efficacy of treatment of knee arthritis and has been shown to be a reproducible, sensitive and quantifiable method to document disease activity.[22,23] Although the present study is the first randomized controlled veterinary clinical trial evaluating acupuncture effects in a naturally occurring disease with thermography, there are several case reports of natural disease documenting temperature change with thermography in individual acupuncture treated patients. For example, Dewey and Gucciardo reported on a 5-year old pit bull mix with intermittent hind leg lameness treated with acupuncture. Initial images revealed different temperature gradients in the right and left hind legs. Fifteen minutes following acupuncture treatment, thermal images demonstrated a dramatically decreased temperature accompanied by a rapid clinical response.[24] In another case report, a 4-year old French Bulldog with intervertebral disc disease (IVDD) was treated with EAP and saw an increase in thermal gradients correlating with the return of neurological function and circulation in the affected areas of the dog's back.[24] A study by Se-Wook et al. evaluated the efficacy of acupuncture on induced arthritis in dogs. Eight dogs were used in this experimental arthritis model which were randomly assigned into two groups [untreated control (n=4) and acupuncture treatment (n=4)]. After receiving acupuncture, once weekly, for a period of four weeks, the temperature in the arthritic joint returned to normal, whereas the temperatures in the non-treatment group remained high. The study concluded that thermography would be useful to evaluate the treatment effect of acupuncture for canine induced chronic arthritis.[25]

Limitations to this study included inability to evaluate long term clinical effects associated with acupuncture associated temperature change. Digital thermal imaging was only performed after the acupuncture treatment, and hence the longer-term (i.e. 30 or 60 minutes) effects from acupuncture treatment could not be assessed. In the clinical practice setting of this study, it was impractical to keep pets and their owners in a strictly controlled experimental environment for long periods of time. Other small issues that were considered to have minimal to no effect on study outcome were loss of acupuncture needles from dogs and movement of dogs during the 15 minute waiting period. Study dogs were generally selected as amicable dogs that had experienced acupuncture treatment before and therefore did not react with much body motion. Loss of needles only occurred in 2 animals (1 needle) and it is expected that retention of these needles would not have affected study conclusions.

Future investigations are warranted as the current study showed a statistically significant effect for acupuncture as measured by digital thermal imaging. By employing an objective measurement of the effects of acupuncture, studies in veterinary medicine could more closely track results in species that are not able to verbally self-report. It would also be important to compare images obtained in a longer time frame as well as linking the findings to clinical assessment of pain after treatment. Directly comparing study groups in the same environment and time frame would allow objective comparison of

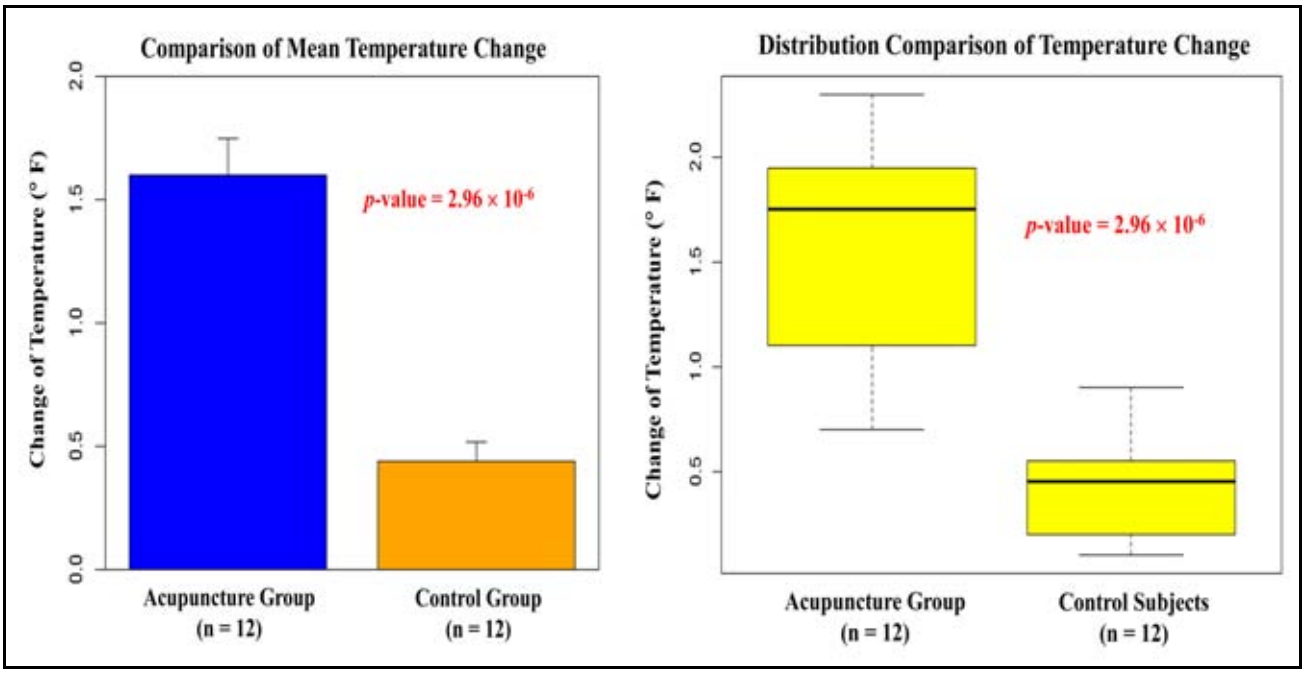

Figure 6: Post-treatment temperature change in each study group; mean and distribution of the temperature change from baseline to post-treatment. The mean temperature change in the Acupuncture Group was 1.60±0.51°F versus Control Group of 0.44±0.26°F. The overall temperature change difference between the two subject groups was statistically significant ($p = 2.96 \times 10^{-6}$).

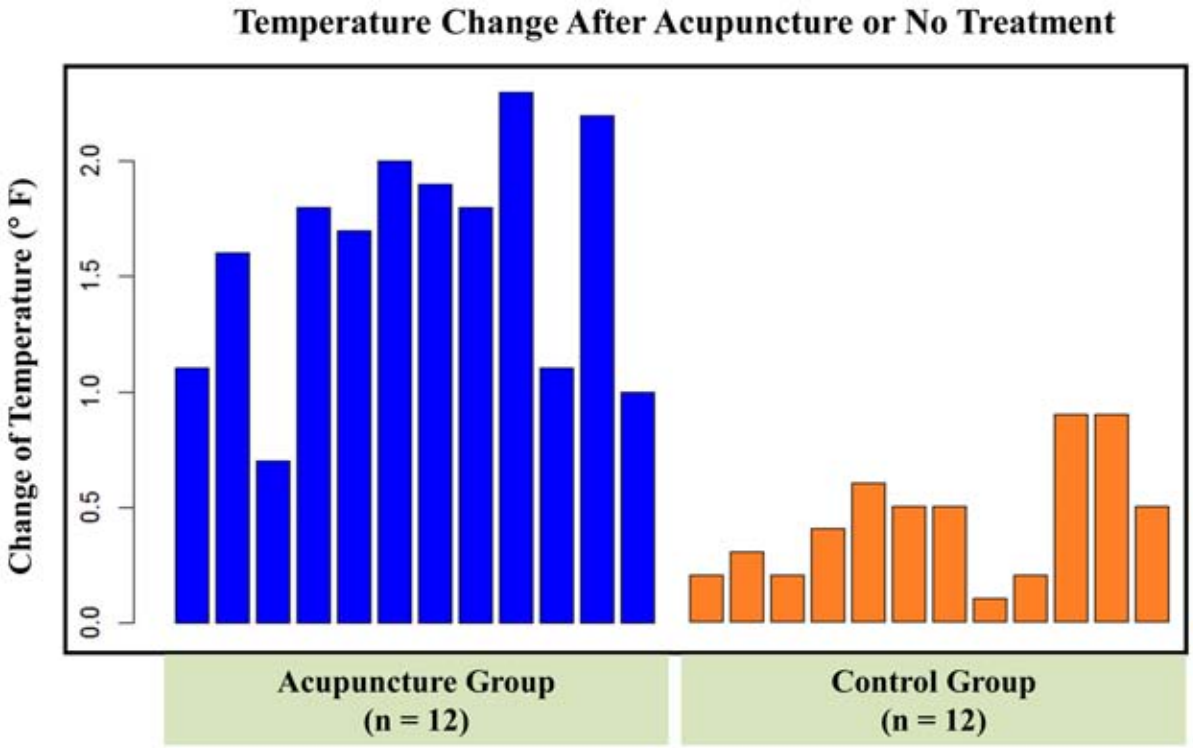

Figure 7: The absolute temperature change value for each individual subject is demonstrated. Temperature change was calculated as the absolute value of the difference between baseline and post-treatment temperature. Visual inspection reveals that individual dogs in the Acupuncture Group had greater temperature changes than those in the Control Group.

targeted acupuncture treatment, no treatment and an off-targeted therapy. Studies could also be designed to investigate the effects of acupuncture on specific conditions in dogs. The prevalent IVDD with its lack of function and perfusion would be a good disease to compare DNAP with EAP effects on the thermal gradients after treatment.

In summary, the results of this study demonstrated an immediate statistically significant difference regarding temperature change measured by digital thermal imaging between the Acupuncture Group and the Control Group. These findings objectively demonstrate that acupuncture has an immediate thermal effect on temperature gradients in dogs experiencing low grade back pain. In addition, this study supports the usefulness of thermography for monitoring therapeutic response to treatment in a non-verbal species and gives clinicians the ability to measure immediate acupuncture effects as well as demonstrate visual changes pet owners can easily appreciate.

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Conflict of Interest

The author declares there is no conflict of interest that could be perceived as prejudicing the impartiality of this paper.

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FOOTNOTES

a. www.randomization.com
b. Digatherm IR Tablet 640, Digatherm, LLC, Ocala, FL, USA
c. Jing Tang Herbal, Inc., Ocala, FL, USA
d. R version 3.5.2. The R Foundation for Statistical Computing, Vienna Austria; http://www.R-project.org

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Efficacy of *Tui-na* Massage in Combination with Conventional Medication for Treatment of Canine Osteoarthritis: A Randomized Controlled Clinical Trial

Maria Isabel Fuentes Beneytez DVM, MRCVS, MS-TCVM

ABSTRACT

The objective of this study was to determine whether *Tui-na* massage in combination with conventional medication (CM) constitutes a more effective treatment for canine osteoarthritis than using CM alone. A total of 47 dogs with radiographic changes consistent with osteoarthritis and already on CM were enrolled in the study. The dogs were randomly assigned to either control (n=24) or experimental treatment groups (n=23). Dogs in the Treatment Group received a weekly *Tui-na* massage for five weeks, whereas those in the Control Group were seen twice, five weeks apart. All subjects continued their CM during the study. Outcome data included scores for range of motion (ROM), walking frequency/duration, quality of life (QoL), pain and weakness collected pre-trial and at study termination. Comparison between groups after five weeks demonstrated significantly greater improvement for the Treatment Group for all outcome data scores: ROM ($p = 1.48\times10^{-10}$), numbers of walks per day ($p = 0.015$), total walking time per day ($p = 2.75\times10^{-5}$), QoL ($p = 1.43\times10^{-8}$), pain ($p = 3.01\times10^{-10}$) and weakness ($p = 1.63\times10^{-9}$). The study findings demonstrate that regular *Tui-na* treatment can serve as an effective coadjuvant in a multimodal treatment and offer statistically significant benefits for dogs suffering from OA.

Keywords: traditional Chinese veterinary medicine, *Tui-na*, massage, osteoarthritis, canine

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ABBREVIATIONS

CM	Conventional medication
GABA	Gamma-aminobutyric acid
MT	Manual therapy
NSAIDs	Nonsteroidal anti-inflammatory drugs
OA	Osteoarthritis
QoL	Quality of life
ROM	Range of motion
TCVM	Traditional Chinese veterinary medicine
TN	*Tui-na*

Osteoarthritis (OA) is a chronic degenerative disease that affects a considerable percentage of the geriatric population around the world. This progressive and destructive process manifests with damaged articular cartilage along with bone remodeling which affects joints creating muscle weakness, loss of function and chronic pain.[1] The disease can be differentiated between early and late changes. In early stages there is loss of elasticity and greater permeability of water which increases chondrocyte stress and exposure to degradative enzymes. In late stages, there is progression to an increase in bone formation, microfractures followed by callus formation, stiffness and restricted motion. Secondary infiltrative inflammation in the soft tissues adjacent to the affected joint create laxity of ligaments and muscle weakness.[1]

Johnston et al. stresses the view of OA as a complex condition, where not only deterioration of the joint with pain and dysfunction is involved but biochemical, physical and pathologic alterations have to be considered.[2] Furthermore, cartilage has a limited self-healing capacity making the treatment of damaged articular cartilage even more challenging.[3-6] Treatment, therefore, depends on many factors which requires a multimodal therapy to palliate them. Commonly this includes a variety of analgesics including combinations of nonsteroidal anti-inflammatory drugs (NSAIDs), intra-articular injection (e.g. steroids, hyaluronic acid), nutritional supplements and physical rehabilitation.[2] The final result culminates in marked reduction of patients' quality of life.[3]

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Author Professional Certifications: CVA, CVCH, CVFT, CVTP

In traditional Chinese veterinary medicine (TCVM), OA is a degenerative disease that involves bones, tendons/ligaments and muscles which presents with the clinical signs of pain and stiffness and is referred to as Bony *Bi* syndrome. Based on TCVM theory, the *Zang-fu* organ, Kidney, controls, among other things, bone, marrow and the central nerve system (CNS). Tendons and ligaments are controlled by the *Zang-fu* organ, Liver, while Spleen, among other things, controls muscles. Pain is created by *Qi* and Blood Stagnation; related to OA's effects on the joints. The most commonly seen TCVM patterns associated with *Bi* syndrome include Kidney *Qi* Deficiency, Kidney *Yin* and *Qi*/*Yang* Deficiency, Painful (Cold) *Bi* and Fixed (Damp) *Bi* syndromes. The general weakness and muscle wasting, *Wei* syndrome, can also be commonly found alongside *Bi* syndromes.[7]

Tui-na (TN) or *Tui-na-an-mo*, is a Chinese manual therapy used for preventing and treating disease and is one of the 4 main branches in traditional Chinese medicine.[8] Primary treatment objectives include helping to soothe joints and sinews, improve Blood flow, soften local tissues, reduce pain and during this process it can help to restructure dense connective tissue.[8] The TN techniques, similar to acupuncture, use fingers instead of needles to apply pressure/stimulate acupuncture points and Channels while other techniques such as stretching or manipulation to improve range of motion (ROM) are applied to the limbs. *Tui-na* massage harmonizes *Yin* and *Yang* along with balancing *Qi* and Blood flow by eliminating blockages associated with disease.[8] It is particularly well suited to treat OA from a TCVM perspective as it addresses and relieves *Qi*/Blood Stagnation in the body and keeps the energy moving through the Meridians.

The objective of this study was to evaluate the efficacy of an integrative treatment that combined TN with CM for treating canine patients suffering from OA. The hypothesis was that a combination of *Tui-na* manual therapy integrated with conventional medication would result in faster and more significant clinical improvement of dogs with osteoarthritis than treatment with conventional medication only without adverse side effects.

MATERIALS AND METHODS

The study subjects were client-owned dogs admitted to Acuvetpet (author's clinic) in Churchdown, Gloucestershire, in the United Kingdom. Inclusion criteria included dogs of any age and gender with (1) radiographic changes consistent with OA in bones and/or joints; (2) currently treated with CM; and (3) informed consent to participate provided by the owner. Exclusion criteria included (1) pain caused by other conditions such as neuromuscular pain, degenerative neuropathy, degenerative myelopathy; and (2) received treatments other than CM (e.g. acupuncture, laser-therapy, chiropractic, osteopathic treatment, massage).

Each subject was randomly assigned to the Treatment Group (CM+TN) or to the Control Group (CM). Randomization was executed through token-drawing from a bag containing an equal number of "treatment" (T) and "control" (C) tokens. Dogs in the Control Group received their usual CM treatment only whereas dogs in the Treatment Group received TN massage for 20 minutes weekly for five consecutive weeks in addition to their usual CM treatment. Conventional medications that study dogs continued during the clinical trial included NSAIDs, analgesics, gamma-aminobutyric acid (GABA)-receptor drugs or a combination of them.

The TN massage was performed by the author, who is a veterinary surgeon and certified *Tui-na* therapist. Each massage session used *Mo-fa*, *Rou-fa*, *Tui-fa*, *Cuo-fa* and *Ba-shen-fa* TN techniques (Table 1).[8] No other massage was performed during the trial by the owner or another therapist so that the outcomes of the study were not confounded. Objective blinded assessment was performed on range of motion (ROM) changes in the dogs (pre-treatment and study termination). Owners were not blinded to the treatment group their dog was allocated to. They performed objective assessments (number of walks each day and duration of each walk) as well as subjective assessments evaluating quality of life (QoL), pain and weakness (Table 2).

Table 1: *Tui-na* techniques used in the treatment arm of the study for dogs affected with osteoarthritis.

***Tui-na* Technique**	**Actions[8]**
Touching skin and muscle (*Mo-fa*)	Harmonizes the Middle *Jiao*, regulates the *Qi,* removes accumulation, and resolves Stagnation
Rotary kneading (*Rou-fa*)	Regulates the *Ying* and *Wei*, unblocks the *Qi* and Blood, extends the chest and regulates *Qi*, eliminates food retention, resolves swelling and relieves pain
Pushing (*Tui-fa*)	Relaxes the tendons, dissipates local Stagnation, excites the muscles, and improves circulation of Blood
Kneading (*Cuo-fa*)	Regulates the Channels, and invigorates *Qi* and Blood
Stretching (*Ba-shen-fa*)	Stretches the tendons, regulates the Channels

Table 2: Outcome data assessed and scoring in study dogs to determine changes in osteoarthritis over a 5-week treatment period.

Clinical Signs Evaluated	Scoring range	Evaluator
Pain: lameness, excess licking affected joints, crying, panting, reluctant to walk or not wanting to walk too far or too long, avoiding getting touched on affected joints	0 = no pain 10 = maximum pain	Owner
Weakness: joint strength, dragging affected limbs, lowered hindquarters, muscle atrophy, proprioceptive deficits, difficulties rising or sitting down	0 = very weak 10 = very strong	Owner
Frequency - Number of walks each day	Objective data	Owner
Duration of walks (total minutes per week)	Objective data	Owner
Quality of Life: OA effect on basics of eating, drinking, urinating and defecating, interacting with family members, interest in participating in family activities	0 = no QoL; 10 = excellent QoL	Owner
Range of Motion	0 = no joint movement 10 = normal joint flexion and extension	Two independent blinded assessors; Scores averaged

OA=osteoarthritis, Qol=quality of life

Table 3: Summary of Breeds that were part of the study.

Control Group	Treatment Group
Border Terrier	Labrador Retriever x Springer Spaniel
Standard Poodle	Labrador Retriever
Labrador Retriever	Springer Spaniel
Old English Bulldog	Labradoodle
Springer Spaniel	Flat Coated Retriever
Lurcher x Staffordshire Bull Terirer	Border Collie
Golden Retriever x Standard Poodle	Border Terrier
Labrador Retriever x Border Collie	Golden Retriever
Labrador Retriever x Staffordshire Bull Terrier	Bull Mastiff x Staffordshire Bull Terrier
Labrador Retriever x Springer Spaniel	Chesapeake Bay Retriever
Jack Russell Terrier	

The study tested the hypothesis that canine patients with OA treated with the combination of TN massage and CM have better treatment outcomes than those treated with CM only. Based on the quantitative measurements, the data analyses tested null and alternative statistical hypotheses. The null hypothesis (H_0) stated the combination of TN + CM results in the same ROM, QoL, weakness, walk frequency/duration and pain score improvement as CM alone for the treatment of dogs with OA. The alternative hypothesis (H_A) stated that the combination of TN + CM results in greater outcome data improvement than CM alone for the treatment of dogs with OA. As the hypotheses compared two independent subject groups with respect to quantitative outcome data (improvement of score), two-sample t or Wilcoxon Rank Sum tests were applied to test the hypothesis, depending on the distribution of the data under inference (normality test).

All tests were two-sided and the null hypothesis was rejected when the resulting *p*-value was less than 0.05. Sample size calculation for the study predicted enrollment of 47 dogs (n=23 or 24 per group), offered a power of over 90% for rejecting the null hypothesis with a 0.05 significance level when the group difference is at least 20% above the sample standard deviation. If Wilcoxon Rank Sum test was used, the test would have approximately 87% power to reject the null hypothesis

with a 0.05 significance level when the probability of a subject in the Treatment Group having more improvement than one in the Control Group was 80%. A commercial statistical software was used for all data graphic presentations and statistical analysis[a].

RESULTS

A total of 47 dogs admitted to the investigator's clinic met the inclusion/exclusion criteria and were enrolled in the study. The group randomization procedure resulted in 24 patients and 11 different breeds in the Control Group (receiving CM only) and the remaining 23 dogs representing 10 different breeds were placed in the Treatment Group (treated with CM + TN) (Table 3). All patients completed the 5-week study experimental treatments and all required assessments for data collection. There were no adverse effects in either study group during conduct of the study.

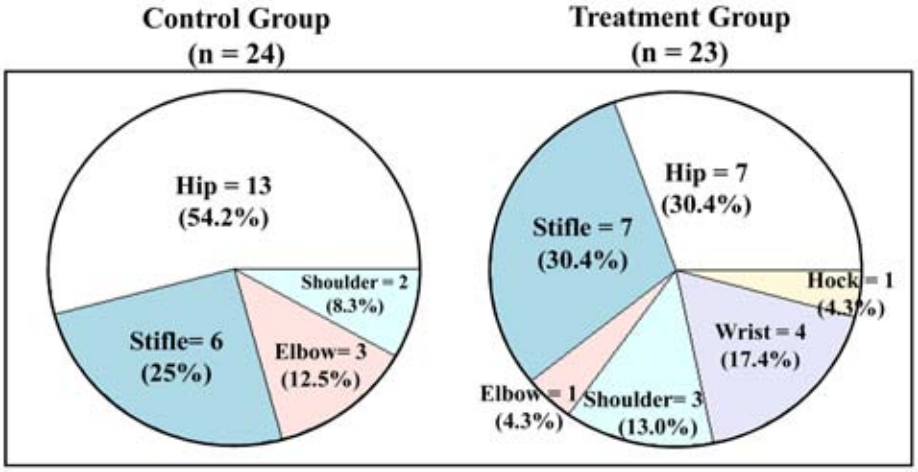

Figure 1: Distribution of OA affected joints in each study group. The two multinomial distributions were not significantly different at a 0.05 significance level ($p = 0.148$) based on Fisher's Exact test.

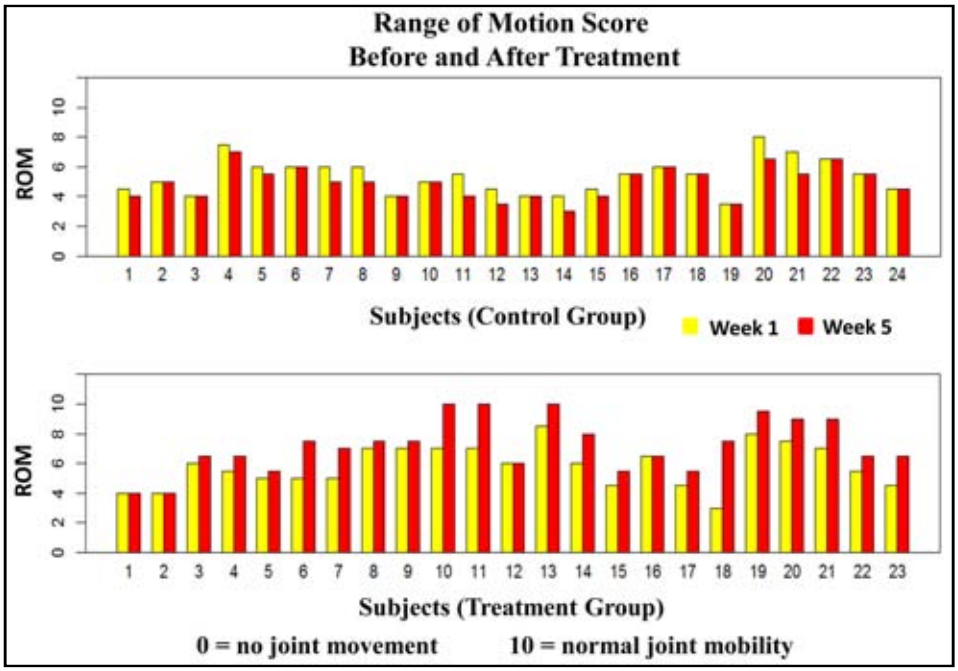

Figure 2: Range of motion (ROM) assessments in each individual subject; mean of two clinicians' ROM was used. Comparison between the two subject groups in terms of the improvement on the ROM suggests that the Treatment Group had significantly better improvement than the Control Group ($p = 1.48 \times 10^{-10}$).

The mean±SD age in the Control Group was 10.63±2.84 years old compared to 10.09±2.94 years old in the Treatment Group (p = 0.467, Wilcoxon Rank Sum test). Individual body weight in the Control Group was 27.46±9.72 kg compared to 26.07±9.91 kg in the Treatment Group (p = 0.608, Wilcoxon Rank Sum test). The distribution of sex in the Control Group was 79.2% (19/24) female vs. 20.8% (5/24) male with the female proportion significantly dominant (> 50%) in the group (p = 0.007, Binomial test). In the Treatment Group, 56.5% (13/23) were female and 43.5% (10/23) were male, which was more balanced (p = 0.678 by Binomial test). Between the two study groups, the proportions of female (or male) were not significantly different (p = 0.125, Fisher's Exact test).

The hip and stifle accounted for the greatest OA incidence in both control and treatment dogs with other joints such as shoulder, elbow, hock and carpus having smaller and more variable incidence (Figure 1). The two multinomial distributions were not, however, significantly different from each other at a 0.05 significance level (p = 0.148) based on Fisher's Exact test.

Range of Motion

For the study, ROM score, ranging from 0 (not able to move the affected joint) to 10 (normal and complete movement of the joint), was evaluated by two independent blinded assessors (veterinary clinicians) at Week 1 and Week 5 (Figure 2). The mean±SD ROM score at Week 1 in the Control Group was 5.35±1.17 and at Week 5 the mean dropped to 4.92±1.07. None of the control subjects' ROMs were improved: 13 unchanged (54.2%) and 11 worse (45.8%). The overall change within the group (mean±SD = -0.44±0.56) was statistically significant (p = 0.001).

In the Treatment Group, the Week 1 mean ROM was 5.83±1.42, which was not significantly different from that of the Control Group (p = 0.222). After 5 weeks of treatment, the mean ROM increased (improved) to 7.20±1.78, which was statistically significant (mean±SD = 1.37±1.15; $p = 3.82\times10^{-6}$). None of the subjects in the Treatment Group had reduced ROMs with 19 improved (82.6%) and 4 unchanged (17.4%). Comparison between improvement of the 2 groups demonstrated a statistically significant difference with respect to the change (Tm > Control, $p = 1.48\text{x}10^{-10}$) (Figure 3, Table 4).

Frequency and Duration of Walk

With more objective assessments, the owners also kept records on the frequency (number per day) and the duration (total minutes during the week) of walks in Week 1 and Week 5. During Week 1 in the Control Group, 10 subjects had 1 walk per day; 10 had 2 per day and 4 had 3 per day (mean±SD = 1.76±0.74; Table 4). After 5 weeks, 12 subjects had 1 walk per day; 11 had 2 per day; and 1 had 3 per day (mean±SD = 1.54±0.59). Nineteen subjects were unchanged and the remaining 5 reduced by 1. This change (-0.21±0.41) was not statistically significant (p = 0.063).

In the Treatment Group at Week 1, there were 13 subjects with 1 walk per day and the rest (10 dogs) had 2 per day (mean±SD = 1.43±0.51). At Week 5, 11 subjects had 1 walk per day and the rest (12 dogs) had 2 per day (mean±SD = 1.52±0.51). Twenty-one subjects were unchanged and the remaining 2 increased by 1 walk (mean±SD = 0.09±0.29; p = 0.500). Comparison between the 2 groups demonstrated a statistically significant difference with respect to the change (Tm > Control, p = 0.015).

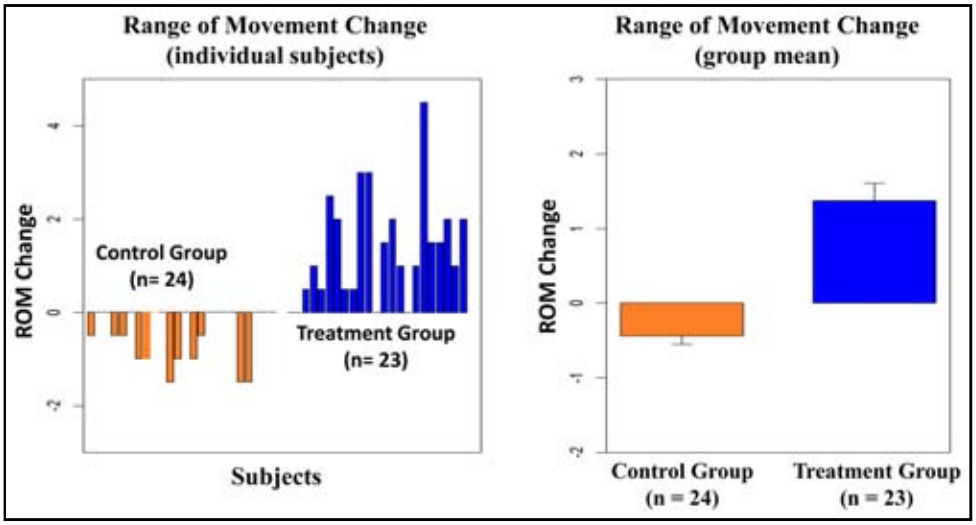

Figure 3: Changes in ROM assessment from Week 1 to Week 5 shows the change of ROM scores from Week 1 and Week 5 individually and within each group. None of the control subjects' ROMs were improved with 13 unchanged (54.2%) and 11 worsened (45.8%) with mean±SD = -0.44±0.56, p = 0.001. None of the subjects in the Treatment Group had reduced ROMs with 19 improved (82.6%) and 4 unchanged (17.4%) with mean±SD = 1.37±1.15; $p = 3.82\times10^{-6}$.

Table 4: Summary table of outcome data results. A decreased pain score equals improvement while all other scores are increased when showing improvement.

	Range of Motion (mean±SD)		Frequency Of Walks (mean±SD)		Duration Of Walks^ (mean±SD)		Quality of Life (mean±SD)		Pain Score (mean±SD)		Weakness Score (mean±SD)	
Control	Pre 5.35 ±1.17	Post 4.92 ±1.07	Pre 1.76 ±0.74	Post 1.54 ±0.59	Pre 49.6 ±29.4	Post 48.8 ±29.7	Pre 8.08 ±0.83	Post 7.75 ±1.29	Pre 4.18 ±1.37	Post 4.79 ±1.69	Pre 5.96 ±1.71	Post 5.54 ±2.06
Change (*p*-value)	-0.44±0.56 (0.001)		-0.21±0.41 (0.063)		-0.83±4.08 (1.00)		-0.33±0.76 (0.125)		0.63±0.92 (0.008)		-0.42±0.72 (0.016)	
Treated	5.83 ±1.42	7.20 ±1.78	1.43 ±0.51	1.52 ±0.51	52.8 ±25.9	68.3 ±31.6	7.26 ±1.14	8.21 ±1.31	4.17 ±1.40	2.48 ±1.83	5.57 ±1.88	7.39 ±1.70
Change (*p*-value)	1.37±1.15 (3.82×10^{-6})		0.09±0.29 (0.500)		15.4±17.0 (2.6×10^{-4})		0.96±0.82 (1.53×10^{-5})		-1.70±1.11 (3.82×10^{-6})		1.83±1.30 (7.63 ± 10^{-6})	
Tm vs Control Improved (*p*-value)	Tm > Control (1.48×10^{-10})**		Tm > Control (0.015)*		Tm > Control (2.75×10^{-5})**		Tm > Control (1.43×10^{-8})**		Tm > Control (3.01×10^{-10})**		Tm > Control (1.63×10^{-9})**	

* Treatment Group has statistically significant improvement when compared to Control Group, $p<0.05$
**Treatment Group has statistically significant improvement when compared to Control Group, $p<0.0001$
^ = minutes; Pre= pre-treatment, Post=post-treatment, Tm=treatment

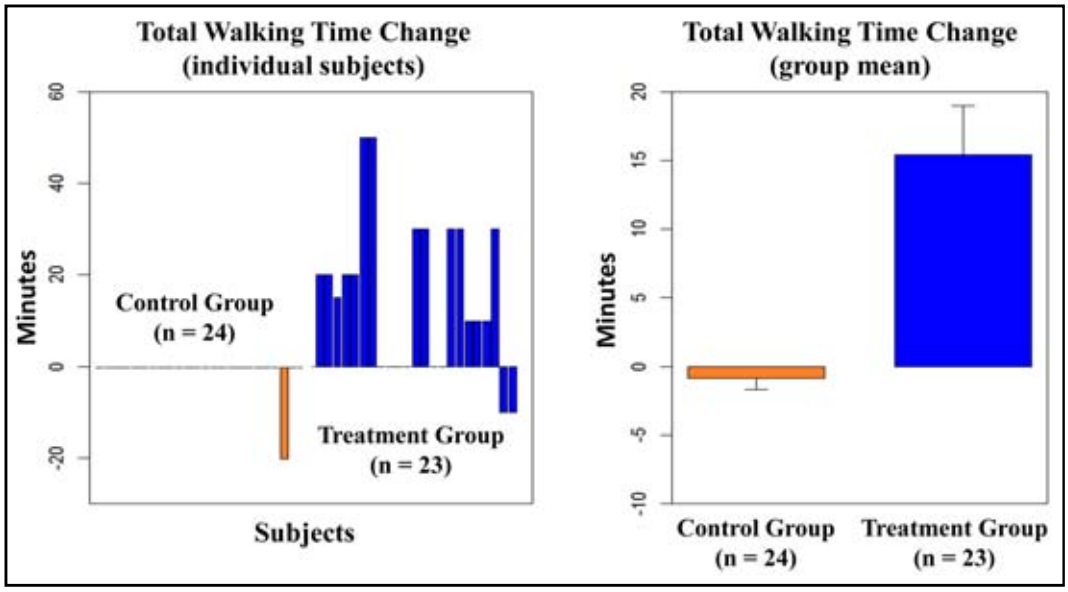

Figure 4: Changes in total walking duration from Week 1 to Week 5. Comparison of total walking time improvement between the two study groups demonstrated a statistically significant difference with the Treatment Group change (increased duration) greater than the Control Group ($p = 2.75\times10^{-5}$).

With respect to the total walking duration within the assessment week, the mean±SD total walking time during Week 1 in the Control Group was 49.6±29.4 minutes and during Week 5 the mean was slightly dropped to 48.8±29.7 minutes. Only 1 out of 24 (4.2%) subjects in the group had reduced total walking time and the time of the remaining subjects were unchanged. Overall, the change within the group (mean±SD = -0.83±4.08) was not statistically significant ($p = 1.00$).

In the Treatment Group, the Week 1 mean±SD total walking time was 52.8±25.9 minutes, which was not significantly different from that of the Control Group

(p = 0.552). After 5 weeks, the mean total walking time increased (improved) to 68.3±31.6 minutes, which was statistically significant (mean±SD = 15.4±17.0; $p = 2.6\text{x}10^{-4}$). Fifteen out of the 23 (65.2%) subjects in the Treatment Group had longer total walking time after 5 weeks; 6 (26.1%) remained unchanged, and the remaining 2 (8.7%) subjects had reduced total walking time. The group difference with respect to the change was statistically significant (Tm>Control, $p = 2.75\times10^{-5}$) (Table 4, Figure 4).

Quality of Life

Similarly, QoL of each subject was assessed by the owner via a QoL score with a range of 0 (no QoL) to 10 (excellent QoL) at the beginning (Week 1) and the end (Week 5) of the study (Figure 5). The mean±SD QoL score at Week 1 in the Control Group was 8.08±0.83 and at Week 5 the mean was slightly dropped to 7.75±1.29 (Table 4). There were 4 out of 24 (16.7%) subjects in the group that had QoL scores that became worse with the scores of the remaining subjects unchanged. Overall, the change within the group (mean±SD = -0.33±0.76) was not statistically significant (p = 0.125).

In the Treatment Group, the Week 1 mean QoL score was 7.26±1.14, which was significantly worse than the Control Group (p = 0.009). After 5 weeks, the mean QoL score increased (improved) to 8.21± 1.31), which was statistically significant (mean±SD = 0.96±0.82; $p = 1.53\times10^{-5}$). Seventeen out of the 23 (73.9%) subjects in this group had improved QoL scores with the remaining 6 subjects unchanged (Table 4, Figure 6). Comparison between improvement of the 2 groups demonstrated a statistically significant difference with respect to the change (Tm > Control, $p = 1.43\text{x}10^{-8}$).

Pain score

Each subject's pain level was assessed both pre-study (Week 1) and at study termination (Week 5) by the owner with scores ranging from 0 (no pain) to 10 (maximal pain) (Figure 7). The mean±SD pain score at Week 1 in the Control Group was 4.18±1.37 and at Week 5 was 4.79±1.69 (Table 4). The pain scores deteriorated (increased pain) in 8 of 24 (33.3%) subjects in the group while scores of the remaining subjects were unchanged. This worsening change within the group (mean±SD = 0.63±0.92) was statistically significant (p = 0.008).

In the Treatment Group, the Week 1 mean±SD pain score was 4.17±1.40, which was comparable to that of the Control Group (p = 0.968). After 5 weeks, the mean±SD pain score dropped (improved) to 2.48±1.83, which was statistically significant (mean±SD = -1.70±1.11; $p = 3.82\times10^{-6}$). Twenty out of the 23 (87.0%) subjects in this group had improved pain scores; the remaining 3 subjects had unchanged scores (Table 4, Figure 8). Comparison between improvement of the 2 groups demonstrated a statistically significant difference with respect to the change (Tm > Control, $p = 3.01\text{x}10^{-10}$).

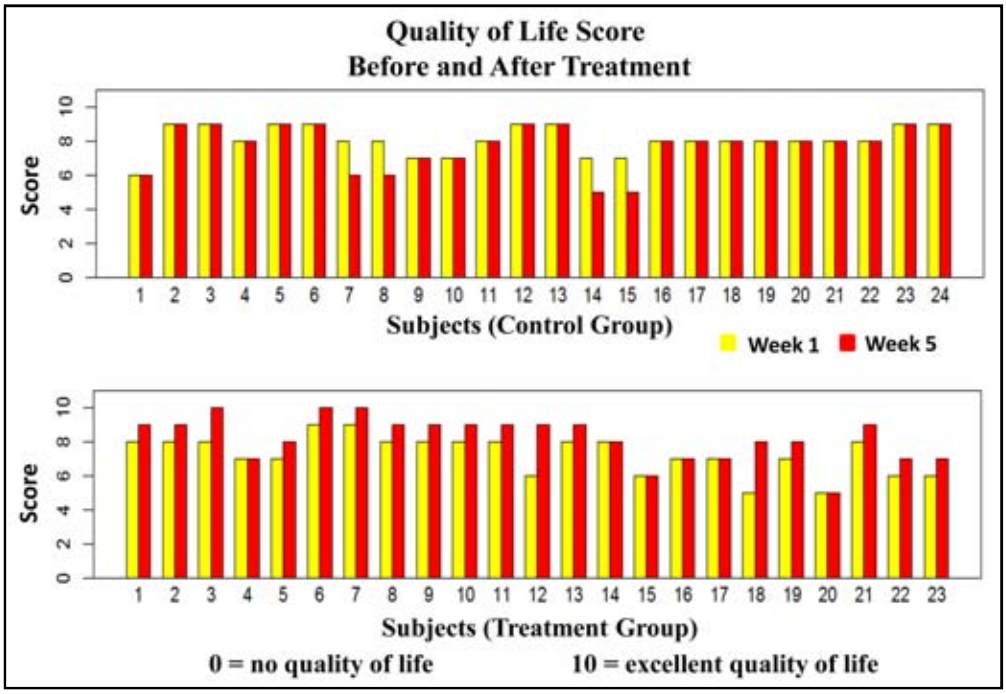

Figure 5: Quality of life scores in each individual subject. When comparing both study groups for QoL score improvement, the Treatment Group had statistically significant greater improvement ($p = 1.43\times10^{-8}$) than controls.

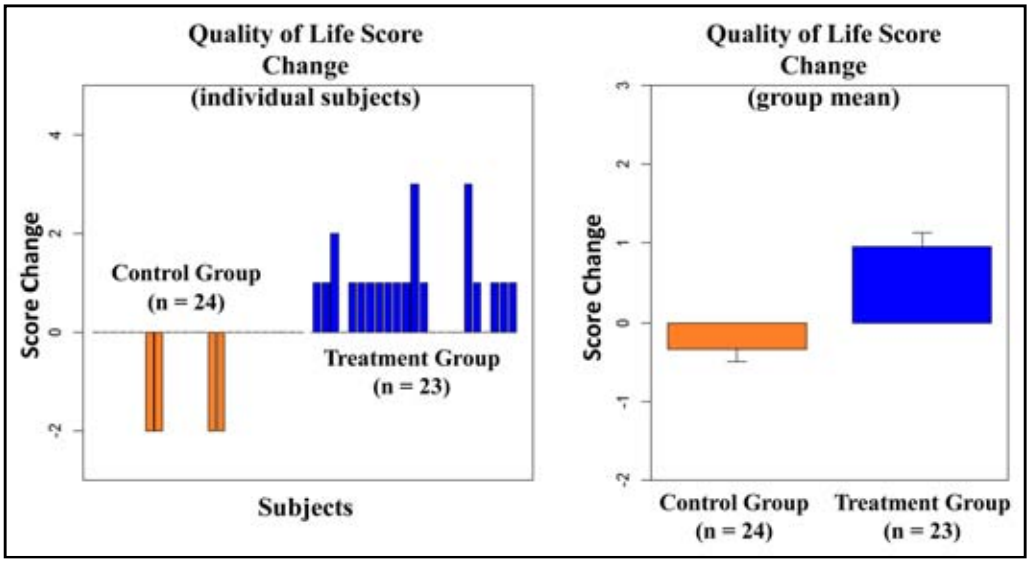

Figure 6: Changes in Quality of life (QoL) scores from Week 1 to Week 5. There were 4 out of 24 (16.7%) subjects in the Control Group that had QoL scores that became worse with the scores of the remaining subjects unchanged (mean±SD = -0.33±0.76, p = 0.125). Seventeen out of the 23 (73.9%) subjects in the Treatment Group had improved QoL scores with the remaining 6 subjects unchanged (mean±SD = 0.96±0.82; $p = 1.53\times10^{-5}$).

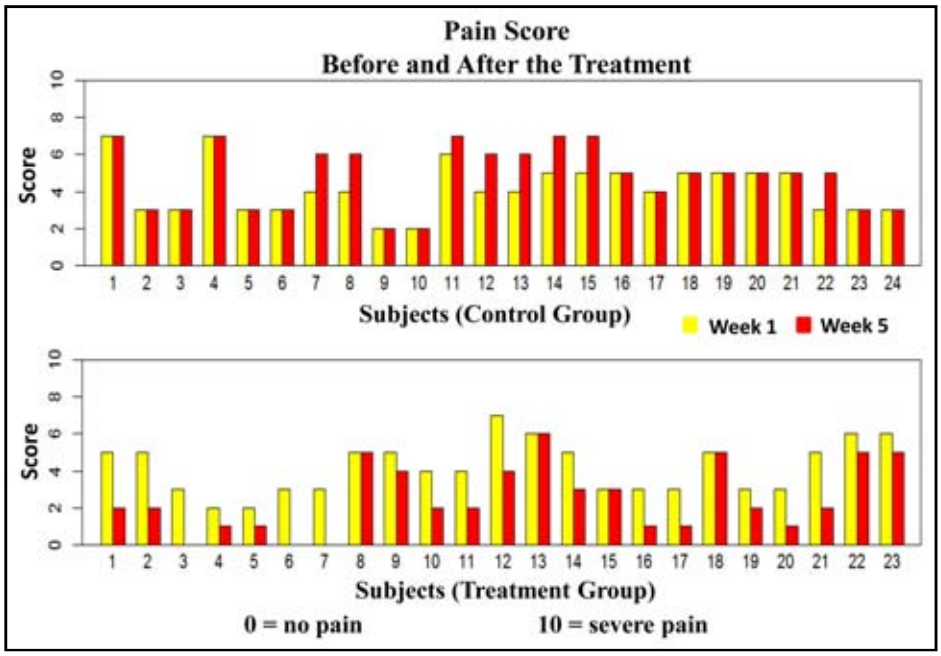

Figure 7: Pain scores in each individual subject (pre- and post-treatment). The Treatment Group had significantly better pain improvement when compared to the Control Group ($p = 3.01\times10^{-10}$).

Weakness Score

Joint strength was also assessed by the owner with a weakness score, ranging from 0 (very weak) to 10 (very strong), at Week 1 and Week 5 (Figure 9). The mean±SD weakness score at Week 1 in the Control Group was 5.96±1.71 and at Week 5 the mean dropped to 5.54±2.06 (Table 4). Seven out of 24 (29.2%) subjects in the group had weakness scores which were worse and the scores of the remaining subjects were unchanged. Overall, the change (weakening of the joints) within the group (mean±SD = -0.42±0.72) was statistically significant (p = 0.016).

In the Treatment Group, the Week 1 mean±SD weakness score was 5.57±1.88, which was comparable to that of the Control Group (p = 0.385). After 5 weeks, the mean weakness score increased (improved) to 7.39±1.70, which was statistically significant (mean±SD = 1.83±1.30; $p = 7.63\times10^{-6}$). Eighteen out of the 23 (78.3%) subjects in this group had improved weakness scores; the remaining 5 subjects had unchanged scores (Table 4, Figure 10). Comparison between improvement of the 2 groups demonstrated a statistically significant difference with respect to the change (Tm > Control, $p = 1.63\text{x}10^{-9}$).

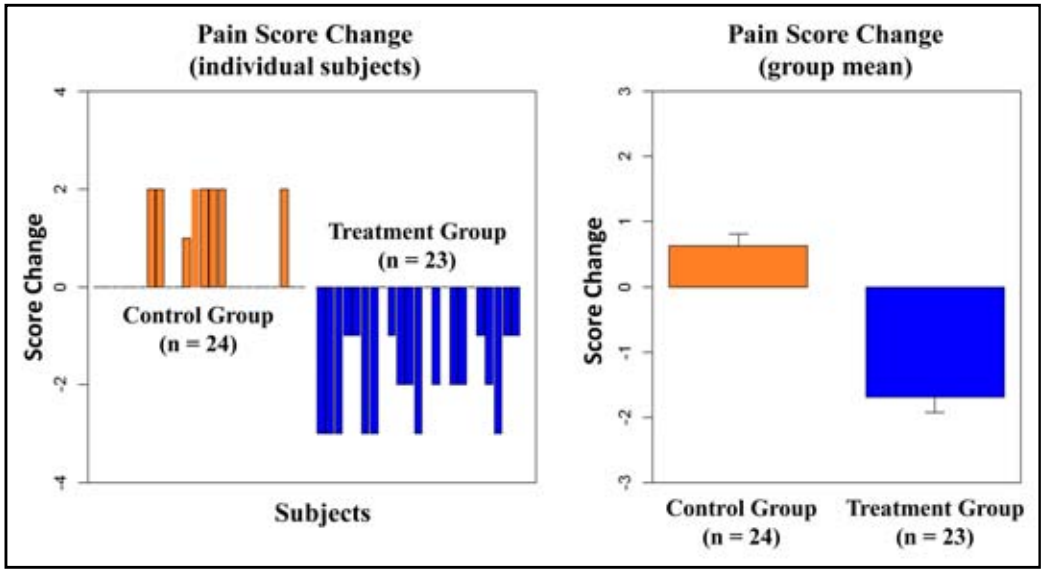

Figure 8: The pain score change (positive = worse; negative = improved) from Week 1 to Week 5 in each subject (left panel) and mean change in each study group (right panel) is demonstrated. There was an increased score in 8 of 24 (33.3%) subjects in the Control Group while scores of the remaining subjects were unchanged (mean±SD = 0.63±0.92, p = 0.008). Twenty out of the 23 (87.0%) subjects in the Treatment Group had decreased pain at Week 5; the remaining 3 subjects had unchanged scores (mean±SD = -1.70±1.11; $p = 3.82\times10^{-6}$).

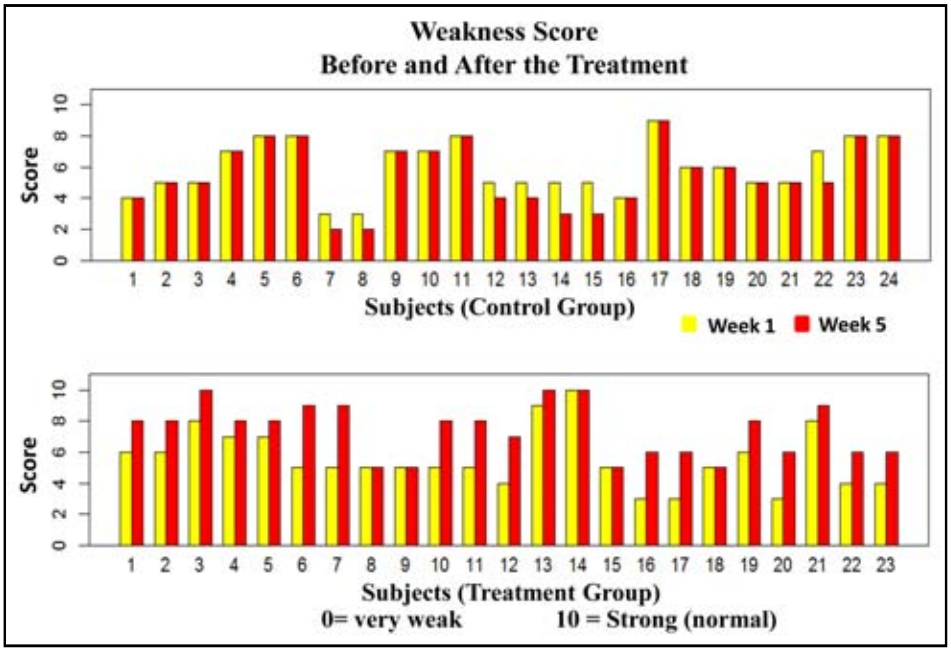

Figure 9: Weakness scores in each individual subject. Comparison between weakness score improvement between the two study groups demonstrated the Treatment Group had significantly better improvement than the Control Group ($p = 1.63\times10^{-9}$).

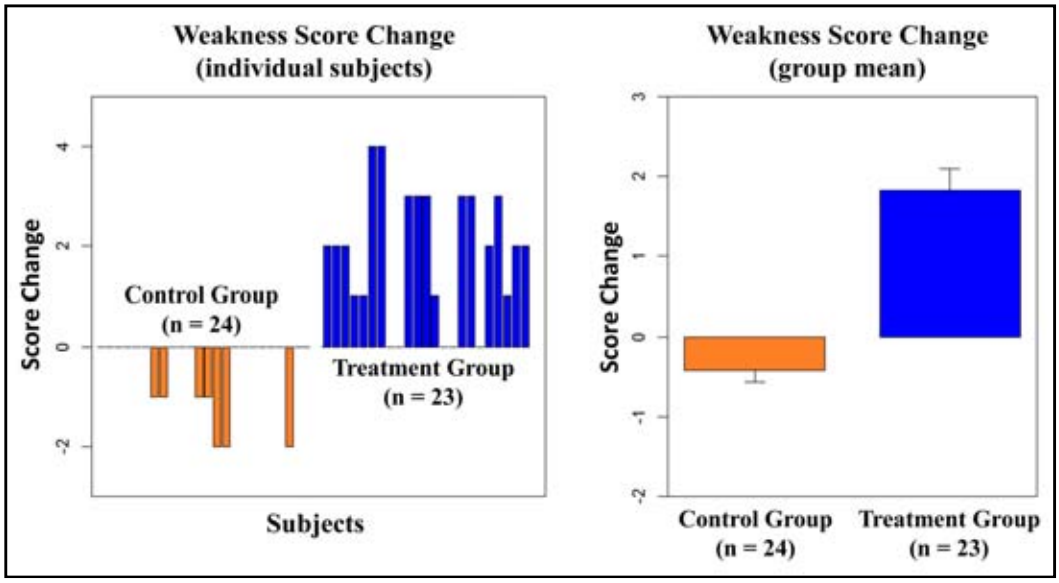

Figure 10: Changes in weakness scores from Week 1 to Week 5; there were 7 out of 24 (29.2%) subjects in the Control Group with increased weakness at study termination while the remaining subjects were unchanged (mean±SD = -0.42±0.72, $p = 0.016$). Eighteen out of the 23 (78.3%) subjects in the Treatment Group had improved weakness scores; the remaining 5 subjects had unchanged scores (mean±SD = 1.83±1.30, $p = 7.63\times10^{-6}$).

DISCUSSION

This randomized controlled clinical study investigated the effectiveness of using conventional therapy combined with *Tui-na* massage to treat canine osteoarthritis (OA). The results of the study demonstrated statistically significant improved joint mobility, increased activity level, less pain, improved strength and quality of life in the experimental group when compared to controls. These findings supported the hypothesis that integrative treatment combining *Tui-na* with conventional medicine constitutes a more effective treatment for canine OA patients when compared with conventional therapy alone without adverse side effects.

Comparison between groups after five weeks demonstrated significantly greater improvement for the Treatment Group when compared to the Control Group for all outcome data scores. Range of motion evaluation by 2 clinicians blinded to study group demonstrated significant improvement in the TN treated dogs with 82% improved versus controls which had 46% of the dogs showing deterioration of the ROM score and 54% unchanged ($p = 1.48\times10^{-10}$). Decreased pain occurred in 87% of treatment dogs versus increased pain in 33% of controls and the remainder unchanged ($p = 3.01\times10^{-10}$). Weakness improvement was similar with 78% of treated dogs showing greater strength while 29% of controls became weaker and the remaining dogs unchanged during the 5 week study period ($p = 1.63\times10^{-9}$). Quality of life followed a similar pattern with 73% of treated dogs with improved QoL compared to 13% of controls with worsening QoL parameters ($p = 1.43\times10^{-8}$).

Most study dogs had unchanged walking frequency (approximately 80% control and 90% treatment). All changes were within 1 walk per day, where 5 control subjects had fewer walks and 2 treatment subjects had more walks (not statistically significant for either group), however, a statistically significant difference was present when the 2 groups were compared ($p = 0.015$). Total walking time (duration) per week showed improvement in 65% of treated dogs while controls remained unchanged with 1 dog that had decreased duration ($p = 2.75\times10^{-5}$).

Additional weekly outcome data showed that patients in the Treatment Group usually started to show improvement after 2 weeks into the treatment. An unexpected finding during the study was that the improvement in treated dogs created a scenario of over-exercise during Week 4 which was associated with slight worsening of some parameters. The affected dogs, however, quickly recovered and showed improvement again in Week 5. One other observation was the greater benefit observed for massage of the shoulders, elbows, hips and stifles when compared to treatment of arthritic carpal joints and hocks. This is similar to observations by other clinicians. In general, the dogs on CM only were stable during the study (unchanged) or mild decreases in individuals, however, the combination of CM with TN massage offered statistically significant better OA treatment success.

Tui-na massage as a manual therapy is an excellent technique to add to the multimodal treatment of OA in dogs, as well as in cats, rabbits, horses and cattle. When applying these manual therapy techniques, one can use hands or other parts of the body such as the elbows, knees, feet or objects as tools. It is low cost, does not

require special equipment and has the side benefits of improving patient-healer bond as well as providing an alternate but effective therapy for individuals that are needle shy. For anxious or restless patients, TN can be a good start for treatment which is then followed by acupuncture. The use of TN readily combines with other TCVM modalities as well as can include the patient's caregiver in their pet's treatment by giving a few easy TN techniques for them to perform daily on their pets.

From the TCVM perspective, selection of *Tui-na* protocols will follow TCVM patterns of disease.[8] The *Zang-fu* organ, Kidney, is associated with bone, therefore, patterns of OA will include Kidney *Qi* Deficiency, Kidney *Yin* Deficiency and combination patterns: Kidney *Qi* and *Yin* Deficiency, Kidney *Qi* and *Yang* Deficiency, Kidney *Qi*, *Yin* and *Yang* Deficiency.[7] As old age progresses, the Kidney becomes deficient in *Qi*. This *Qi* Deficiency Pattern causes the abnormal growth and degradation of bone in the joint area and sometimes neurological deficits as well. A *Yin* Deficiency Pattern is diagnosed when symptoms of general Heat and dryness are observed, whereas, a *Yang* Deficiency Pattern is diagnosed when symptoms of general Cold are present.[7] Also involved in OA is the Liver which usually presents as a Blood Deficiency or the lack of nourishment of tendons and ligaments that compose the affected joint. In some cases, the Spleen may be involved with the most common TCVM pattern related to OA as a *Qi* Deficiency associated with muscle atrophy and weakness or lack of strength.

Regarding manual therapy for the treatment of OA, other authors have come to similar conclusions and findings as the present study. In a human clinical trial investigating knee OA, the combination of exercise and massage therapy showed greater benefit at 9 weeks than exercise alone, however, to maintain benefits at 1 year, booster sessions were important.[9] Another human clinical study which was set up as a randomized controlled trial with assessor blinding compared treatment of hip OA with manual therapy or exercise therapy. Both groups participated in 25-minute sessions twice a week for nine weeks. Outcomes (improved, stable, worse) were assessed at 5, 17 and 29 weeks by multiple assessments including quality of life. Study findings demonstrated manual therapy had greater improvement of hip OA than exercise therapy.[10] In a systematic review, exercise alone, strength training alone and a combination of exercise and manual mobilization were compared for treatment of knee OA in humans. Study findings showed exercise plus manual manipulation demonstrated a moderate effect for pain relief versus only a small effect for the other 2 groups. The authors recommended therapists should consider adding manual mobilization to achieve better pain relief in OA patients.[11]

In veterinary patients, a clinical trial concluded that the beneficial effects of massage therapy, both physically and psychologically, for small animals is equal to humans.[12] The benefits included improvement of muscle contractures and spams, flexibility, range of motion, performance, pain, stress, anxiety and quality of life. This study used human massage techniques that can be extrapolated to small animals including effleurage, kneading, petrissage, friction, tapotage, vibration and shaking.[12] A similar conclusion on the use of manual therapy in animals was presented by another author who supported a multimodal approach to the treatment of osteoarthritis. Physiological and anatomical similarities between dogs, cats and humans was pointed out which makes the discoveries in humans related to massage applicable to these animals.[7] The massage techniques recommended were similar to the previous author and included stroking, effleurage, compression, kneading and wringing, friction and percussion.[13] All of these techniques have a correspondence in TN massage, with TN offering the additional benefit of an individualized treatment protocol based on TCVM pattern diagnosis.

Clinical research has provided insights into potential underlying mechanisms for reduction of pain associated with massage. The mechanism most frequently cited is the Gate Control Theory.[14] Pain stimulates shorter less myelinated nerve fibers which take longer to reach the brain than massage associated pressure signals which are carried by longer faster myelinated fibers which "close the gate" before the pain response arrives.[14] Additionally, massage increases production of the anti-pain neurotransmitter, serotonin, which is associated with decreased levels of substance P (increases pain perception and inflammation).[15,16]

Other benefits of massage's mechanical pressure appear to be increased blood flow to affected areas by increasing the arteriolar pressure and increasing muscle temperature from rubbing.[14] Depending on the massage technique, mechanical pressure on the muscle is expected to increase or decrease neural excitability.[17] A reduction in the stretch reflex would be desirable because spinal hyperexcitability is associated with chronic pain syndromes.[18] More widespread systemic effects include stimulation of pressure receptors which enhance vagal activity and produce changes in parasympathetic activity. This includes lower heart rate and blood pressure and measurably lower levels of cortisol. One study pointed out massage appeared to be more effective than anti-hypertensive drugs in lowering systolic and diastolic blood pressure.[19] Finally there have been some interesting studies documenting immunomodulation with lower production of cytokines (pro-inflammatory cells associated with Th2) which would benefit the inflamed joints associated with OA.[14]

Limitations in this study included potential bias of unblinded owners evaluating parameters such as pain, weakness and quality of life. Objective measures were also used which yielded similar statistically significant findings. These included range of motion evaluated by blinded veterinary evaluators and owner objective measures such as frequency and duration of daily walks. The range of motion scoring measurements (0-10) would be improved by using angle calipers with the aid of a trained assistant. Study quality would also benefit from

including post-study measurements at week 2, 4, 6 and 8 for measurement of length of residual massage effects. Some studies have suggested post-treatment benefits of up to 2 months following cessation of massage.[14] Finally, outcome variation could be mitigated (thus enhance the study power) by reducing the number of joints included in the study (e.g. shoulders, elbows, hips, stifles only).

In summary, the present study found that dogs undergoing five weekly TN treatment sessions integrated into their usual treatment for osteoarthritis had decreased pain, improved activity levels, more strength in affected limbs and improvement in the ROM and QoL. These effects were seen as early as 2 weeks after study start. Based on study findings, the combination of CM with TN massage can offer better opportunities of success in the treatment of these patients than treatment with CM alone and is recommended as a beneficial adjunct to conventional treatments for canine osteoarthritis.

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FOOTNOTES

a. R version 3.5.2; 2018-12-20, The R Foundation for Statistical Computing, Vienna Austria; http://www.R-project.org

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Preoperative Oral Administration of *Yunnan Baiyao* and Its Effect on Coagulation Parameters in Tick-Borne Disease and/or Heartworm Seropositive Dogs: A Pilot Study

Adria I. Rodriguez DVM, MSc, MS-TCVM*, Deng Shan Shiau PhD,
Keri Levinson DVM, Elizabeth Peck DVM

ABSTRACT
The overall goal of this clinically focused pilot study was to investigate the preoperative benefit of oral administration of *Yunnan Baiyao* (YB) to *Ehrlichia. canis*, *Anaplasma platys* and/or heartworm seropositive canines. A total of 12 clinically normal dogs undergoing sterilization procedures were randomly subdivided into Control/Placebo Group (n=6) or Treatment Group (n=6). Each patient received three oral doses of YB (0.5g/5kg) or placebo every twelve hours with the last dose given the evening before surgery. Citrated blood measurements for prothrombin time (PT), activated partial thromboplastin time (aPTT), and fibrinogen were obtained before the first YB dose and after the third dose. Intraoperative blood loss was estimated by blood-soaked gauze sponge counts. The study found the Control Group's mean aPTT increased by 3.8% while the Treatment Group's decreased by 0.42%. PT values were slightly decreased in both groups. Fibrinogen decreased in controls (9.7%) but had a modest increase in treated dogs (12.4%). Intraoperative blood loss was increased in controls (3%) compared to the Treatment Group (mean±SD: 6.6±6.8 vs. 6.4±3.6, respectively). Findings from the study which suggest preoperative benefits from YB administration to seropositive dogs include stabilizing aPTT and fibrinogen values along with reduced intraoperative blood loss in YB treated dogs. Although these modest findings were not statistically significant in this small study, the biological trends suggest potential benefits of preoperative administration of YB before routine elective surgeries in seropositive patients and support a clinical trial with larger sample size.

Keywords: *Yunnan Baiyao*, ovariohysterectomy, castration, blood loss, coagulation parameters, tick-borne disease, heartworm disease

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ABBREVIATIONS

aPTT	Activated prothrombin time
EACA	Epsilon aminocaproic acid
PT	Prothrombin time
TA	Tranexamic acid
YB	*Yunnan Baiyao*

From: Faculty Small Animal Medicine and Surgery Department, School of Veterinary Medicine, St. George's University, True Blue, Grenada (Rodriguez); Faculty, Chi University, Reddick, FL USA (Shiau); Blue Pearl Specialty Clinic, Rockville, MD USA (Levinson); Advanced Veterinary Specialists, Santa Barbara, CA USA (Peck); School of Veterinary Medicine, St George's University, True Blue, Grenada, prior to current professional affiliation (Levinson, Peck)
Professional Certifications: CVA, CVCH (Rodriguez)

Veterinarians and veterinary students perform sterilization procedures, namely ovariohysterectomies (OVH) and orchiectomies, routinely all over the globe. These are standard surgeries, yet blood loss factors need to be taken into consideration such as patient preoperative status, concurrent diseases and surgeon technique.[1] The concern for excessive bleeding is increased for veterinary patients seropositive for tick-borne diseases and/or heartworm disease. The rickettsiae *E. canis* and *A. platys* are transmitted by ticks, and it has been demonstrated that dogs who are seropositive for both have a greater tendency to ooze and bleed during surgery in comparison with seronegative patients.[2] Identifying a treatment which can reduce the excessive bleeding tendency in these seropositive patients, particularly in areas of the world that have high infectivity rates with these organisms, would be beneficial. In Grenada, there is a high prevalence of tick-borne disease, and experiential

evidence has found that it is appropriate to do surgery on these seropositive patients once their platelet counts and hematocrit levels (platelets >150,000, HCT >30%) as well as other preoperative criteria for the surgical lab are within acceptable limits. This becomes of note since some patients who are seropositive may not come back if rejected for surgery, thus reducing the chance for population control. Patients who are evaluated for surgery and fall below the acceptable ranges are treated for disease before being considered for surgery. Subclinical seropositive patients who undergo surgery are normally sent home with treatment post-operatively.

Conventional hemostatic agents commonly used peri- and intraoperatively in veterinary medicine include the antifibrinolytic drugs tranexamic acid (TA) and epsilon aminocaproic acid (EACA).[3-8] The drug TA is available as an injectable solution and may also be used topically. Common side effects include vomiting due to hypotension and a risk of thrombosis, which present a shortcoming when considering administering the drug to a patient.[1] Epsilon aminocaproic acid can be administered orally or IV with side effects that may include hypotension and thrombi generation. It is therefore important to weigh the benefits over the complications.[4]

The herbal formula *Yunnan Baiyao* (YB) originated in the Yunnan Province, China and was developed by Doctor Qu Huan-Zhang around 1902 for the purpose of removing blood stasis, stopping bleeding, relieving pain, detoxifying, and reducing swelling.[9] Its hemostatic effects and safety have been demonstrated across multiple species. Both oral and topical application of YB significantly shortened bleeding times in rats and time to blood clot formation in rabbits and humans.[10] It has also been widely used during times of war to treat injuries.[9] It is commonly used in traditional Chinese medicine (TCM) and traditional Chinese veterinary medicine (TCVM) as it has hemostatic indications and is known to cause fewer side effects (rare mild diarrhea) than its conventional medicine counterparts, TA and EACA.[11,12]

Ladas et al. described the use of YB "in adolescents with cancer as an adjunct to uncontrolled bleeding in the palliative care setting" in a retrospective case-series report. YB solution significantly decreased clotting time when compared to saline control, starch and starch with calcium comparisons in rabbit and human blood.[13] Results in a canine study investigating blood loss and coagulation following nasal biopsy in YB treated dogs and controls demonstrated that the time to stop bleeding was significantly shorter ($p<0.05$) in the YB group when compared to controls and was not influenced by underlying disease. There was also decreased blood loss as a percent of body weight when YB treated dogs were compared to controls (14% vs 25% respectively).[10] No study has explored the effects of administration of YB to *E. canis*, *A. platys*, and/or heartworm seropositive dogs.

The objective of this pilot study was to explore the potential of preoperative oral administration of YB in reducing intraoperative bleeding in dogs who were seropositive to tick-borne diseases and/or heartworm disease, as well as blood coagulation parameters, PT, aPTT and fibrinogen. The significance of finding an effective treatment is supported by studies demonstrating increased perioperative bleeding/oozing tendency in these dogs, even if they do not show clinical signs. It was hypothesized that a small pilot study would be an effective use of resources to evaluate YB's potential as an effective hemostatic agent for parasitized dogs and if positive effects were observed (blood loss reduction and/or coagulation parameter changes), then a larger clinical trial could be recommended.

MATERIALS AND METHODS

The subject population under investigation in this study was intact canines presenting to the St. George's University School of Veterinary Medicine Junior Surgery and Anesthesia Laboratory (SGUSVM JSAL) for elective sterilization procedures. The recruited study patients were predominately Grenada's indigenous mongrel breed (Pothounds) from different parishes. The SGUSVM had an existing partnership with the organization Pothounds Against Pregnancy (PAP) at the time of data collection. The organization traveled around the island and recruited patients that were transported to the JSAL for evaluation and admission for elective sterilization surgery. With

Table 1: St. George's University School of Veterinary Medicine Junior Surgery and Anesthesia Laboratory Premedication Protocol for elective sterilization procedures.

Orchiectomy Premedication		
Drug	Dose	Route
Acepromazine (10 mg/mL)	0.05 mg/kg	IM
Morphine (10 mg/mL)	0.3 mg.kg	IM
Ovariohysterectomy Premedication		
Drug	Dose	Route
Acepromazine (10 mg/mL)	0.05 mg/kg	IM
Morphine (10 mg/mL)	0.5 mg.kg	IM

Institutional Animal Care and Use Committee (IACUC) approval of the study, owners signed a unique research consent form to allow their pet to participate in this study. The inclusion criteria included: (1) age 6 months to 8 years; (2) male or female; (3) hematocrit > 29.5%; (4) Platelets > 150,000 × 10^3/L; and (5) SNAP 4Dx[a] seropositive for *Ehrlichia canis*, and/or *Anaplasma platys*, and/or heartworm disease. Patients were excluded from the study if (1) body condition score was < 2/5; and/or (2) had any disease process diagnosed by physical exam and/or blood work findings that prevented the patient from being fit for surgery.

All patients arrived between the Sunday and Tuesday afternoons preceding scheduled surgeries for Thursday of that week. All surgery patients were examined upon arrival by a JSAL clinician and approved for surgery after the selection criteria were confirmed. A complete physical examination, complete blood count (CBC), pre-anesthetic panel, and a SNAP 4Dx© test were performed on every patient. Enrolled patients were randomly divided into the seropositive Control/Placebo Group and seropositive Treatment Group. Randomization was conducted by writing down numbers on a piece of paper and randomly drawing from a pile and consequently assigning patients to one of the two study groups. The person drawing the numbers was blinded to the patients' medical record.

For patients in the Treatment Group, YB[b] was administered orally at a dose of 0.5g per 5kg twice a day (BID), and each patient received a total of three doses. Each 0.25g capsule of YB was placed in a pill pocket[c] and the appropriate dose was administered orally. The patients in the Control/Placebo Group received the appropriate number of empty pill pockets orally according to their weight (1 pill pocket per 5kg) without YB. The individuals administering the placebo or YB treatment were blinded to the patient's study group assignment.

Once the patients were enrolled in the study, the blood draw to obtain baseline coagulation parameters, PT, aPTT, and fibrinogen, was performed on Tuesday afternoon after the arrival of the last enrolled patient. A 3-cc syringe with a 22-gauge needle[d] was used to collect a 2-cc blood sample from the jugular vein. The blood was transferred to a 1.8 ml blue top tube containing sodium citrate by removing the needle from the syringe, removing the tube top, and dispensing the blood directly into the tube. The samples were immediately placed on a rocker. The rest of the samples were obtained in the same manner. Sample collection took approximately 15-30 minutes depending the patient's demeanor, cooperation, and number in the group.

The blood samples were taken to the SGUSVM clinical pathology laboratory and processed to obtain baseline PT, aPTT and fibrinogen parameters for each patient. The VetScan® VSPro analyzer[e] was used with the appropriate cartridges for each test. A total of 2-3 samples were processed at a time within a 1hour time block. The number of samples was contingent upon the number of patients recruited for the study that specific week.

Table 2: Study population age, sex, and seropositive status of study dogs.

Group / Dog Number	Sex	Age (years)	Weight (kg)	Seropositive Status
C / 1	M	5	16.4	Heartworm
C / 2	F	1	10.2	Ehrlichia
C / 3	F	3	19.2	Heartworm
C / 4	F	4	15.4	Ehrlichia
C / 5	F	3	14.7	Heartworm
C / 6	F	3	8.2	Ehrlichia+Heartworm
Overall	85.3% Female	mean±SD = 3.17±1.33	mean±SD = 14.0±4.08	
T / 1	F	4	14.6	Ehrlichia
T / 2	F	1.25	13.8	Heartworm
T / 3	F	5	10.0	Heartworm
T / 4	F	3	11.6	Heartworm
T / 5	F	5	10.3	Ehrlichia+Anaplasma
T / 6	F	1	10.4	Ehrlichia
Overall	100% Female	mean±SD = 3.21±1.78	mean±SD = 11.8±1.97	

C = Control group; T = Treatment group

After the patients received either three doses of the placebo or treatment YB (Tuesday night, Wednesday morning, Wednesday night), the post-administration blood sample collection and processing took place on Thursday morning at 8:15am before the scheduled surgery. Due to logistics involving the efficient running of the JSAL, the blood samples had to be collected after premedication of the patients (Table 1). After premedication of the patients and IV catheter placement, 2-cc of blood was collected directly from the IV catheter and into a 1.8 ml blue top tube containing sodium citrate, and the tube was immediately placed on a rocker. Sample collection time ranged from 10-15 minutes. The blood samples were then taken to the SGUSVM clinical pathology laboratory and processed to obtain post-dosing PT, aPTT, and fibrinogen parameters for each patient. The same procedure and equipment used for obtaining the baseline data was utilized.

In addition to the three coagulation parameters, the amount of blood loss during the surgery was estimated for each patient. Once the neuter or spay was performed, the assistant surgeon counted the gauze sponges used during the procedure. Calculation of estimated blood loss was done by counting how many 4" × 4" gauze sponges of the same material and brand were used intraoperatively and by visually estimating the degree of blood saturation of each gauze sponge, using the assumption that each fully saturated gauze sponge holds approximately 5 ml of blood.

Outcomes of the measurements, including those derived from pre-treatment data, post-treatment data, and their differences, were reported with summary statistics (mean±SD, median, % change). The Wilcoxon signed rank test was employed for testing the within-group changes (i.e. pre- vs. post-treatment) and the Wilcoxon rank sum test was applied for between-group comparisons. Significance level was set to be 0.05, although it is understood that, as a pilot study, the group sample size was small (n = 6) for any meaningful statistical significance test (power ≈ 65% and 40% for within-group and between-group tests, respectively). A commercial statistical software was used for all data graphic presentations and statistical analyses[f].

RESULTS

Based on the established criteria, a total of 12 dogs (1 male, 11 female) were enrolled in the study. All dogs were seropositive for either E. canis, *A. Platys* and/or heartworm disease: 6 heartworm positive, 4 Ehrlichia positive, 1 Ehrlichia/heartworm positive and 1 Ehrlichia/Anaplasma seropositive. Randomization resulted in 6 in the Control Group and 6 in the Treatment Group (Table 2).

The mean±SD age in the Control Group was 3.17±1.33 years versus 3.21±1.78 in the Treatment Group. The difference was not statistically significant between the two groups (p = 0.89). The mean±SD body weight in each study group was: 14.0±4.08 (control) and 11.8±1.97 (treatment), which was not significantly different (p = 0.31).

The mean±SD PT before treatment was 17.4±0.9 in the Control Group and was 17.2±0.6 in the Treatment Group (p = 0.85) (Tables 3 and 4). Both groups' PT was decreased after the treatment. The mean±SD values of PT change were -0.90±0.44 and -0.13±0.79 in the control and the treatment groups, respectively (Figure 1, Table 5). Based on Wilcoxon Signed Rank test, the change in the Control Group was statistically significant (p = 0.03) but was not significant in the Treatment group (p = 0.75). The between-group difference for PT changes was not statistically significant (p = 0.13).

The mean±SD aPPT before the treatment was 90.9±3.6 in the Control Group and was 89.9±10.1 in the Treatment Group (p = 0.59) (Tables 3 and 4). After treatment, the aPPT was increased in the Control Group, but was decreased in the Treatment group (Figure 2). The mean±SD values of aPTT change were 3.5±5.7 (p = 0.22) and -0.38±9.0 (p = 1.00) in the Control and the Treatment groups, respectively (Table 5). The between-group difference for aPTT changes was not statistically significant (p = 0.48).

The pre-treatment fibrinogen mean±SD was 3.62±1.91in the Control Group and was 2.58±0.82 in the Treatment Group (p = 0.97) (Tables 3 and 4). After treatment, fibrinogen was decreased in the Control Group

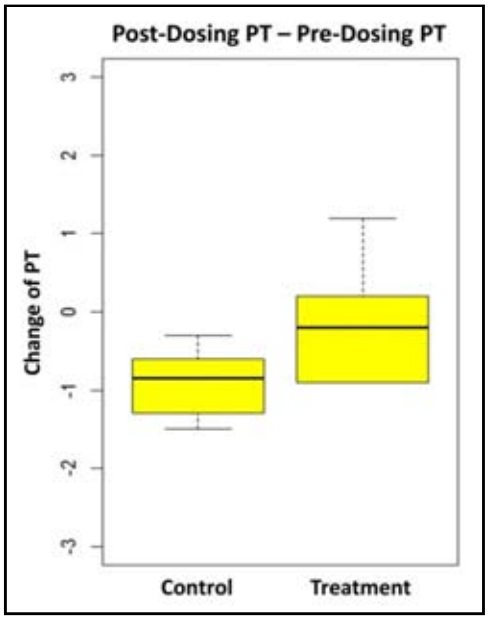

Figure 1: Distribution of prothrombin time change depicted by a box-plot for each of the study groups. The lower and upper bounds of the rectangle box are the 1st and the 3rd quartiles (Q1 and Q3), respectively, of the observed data. The thick horizontal line inside the box is the median. The whiskers (lines outside the box) are the highest and lowest observations. A box-plot without a bottom whisker (as in the present case) indicates that the 1st quartile (bottom of the rectangle box) is the same as the minimum in the Treatment group. This figure description also applies to Figures 2, 3 and 4.

(mean±SD change = -0.35±0.67, p = 0.34), but was increased in the Treatment group (mean±SD change = 0.32±0.18; p = 0.063) (Figure 3, Table 5). The between-group difference for fibrinogen changes was not statistically significant (p = 0.32).

Percent peri-operative blood loss was calculated by taking 8% of the patient body weight (total blood mL) and dividing the estimated blood loss by the total blood volume (Figure 4). The mean±SD values of blood loss were 6.60±6.78 in the Control Group and was 6.43±3.63 in Treatment Group (Tables 3-5). The between-group difference for blood loss was not statistically significant (p = 0.70).

DISCUSSION

The hemostatic effects and safety of *Yunnan Baiyao* have been demonstrated across multiple species along with its ability to control blood loss when given prior to surgical procedures.[10,12] The objective of this pilot study was to investigate the intraoperative hemostatic effects of presurgical administration of YB to dogs testing seropositive for tick-borne diseases (*E. canis*, *A. platys)* and/or heartworm disease. Intraoperative blood loss and changes in coagulation factors (PT, aPTT, fibrinogen) prior to surgery were evaluated in 6 patients receiving 3 doses of YB (last dose night before surgery) and 6 controls. Changes of interest included improved aPTT (quicker clot formation) in the YB treated dogs (reduction of 0.42%) while untreated seropositive dogs had an increased aPTT by 3.8%. Fibrinogen levels also displayed a positive change with increased fibrinogen value (12.4%) associated with YB treatment versus seropositive controls whose value decreased by 9.7%. The YB treated group also had less intraoperative blood loss (3%) than the untreated seropositive controls (mean±SD: 6.4±3.6 versus 6.6±6.8, respectively). The PT value decreased slightly in both groups. All beneficial changes noted with pre-surgery YB treatment in seropositive dogs suggested biological trends yet were not large enough to show statistical significance in the small group numbers utilized in this study. The findings do satisfy the hypothesis that this pilot study would demonstrate YB pre-surgical administration benefits and support a larger clinical trial to see if these findings can be replicated with statistically significant results.

The comparison of blood loss in seropositive dogs treated with YB to untreated seropositive dogs defines the most important objective of this study. This part of the investigation demonstrated that there is benefit in giving YB prior to surgery as there was a reduction in blood loss in these dogs. When investigating mechanisms of action with this Chinese herbal medicine, in addition to reduction of blood loss, there has been interest in the anti-inflammatory effects of YB. Of particular interest is its effects on the arachidonic acid metabolite pathways in acute inflammation rat model studies.[14] It has shown comparable activity in the carrageenan-induced rat paw edema model with the Cox-2 inhibitor, celecoxib. In addition, it demonstrated similar anti-inflammatory activity to the antihistamine, mizolastine, in the arachidonic acid induced inflammation model in which celecoxib is not effective.[14] In this same model, YB exerted statistically significant suppression of the leukotriene B4 (LTB4). This would be particularly beneficial to dogs with an injured vasculature from this inflammatory cytokine as it is a potent chemotactic factor for induction of leukocyte adhesion and injury to vascular endothelium. Ongoing chronic vascular injury from parasitism has been hypothesized to likely exacerbate bleeding during surgery in these dogs.[2]

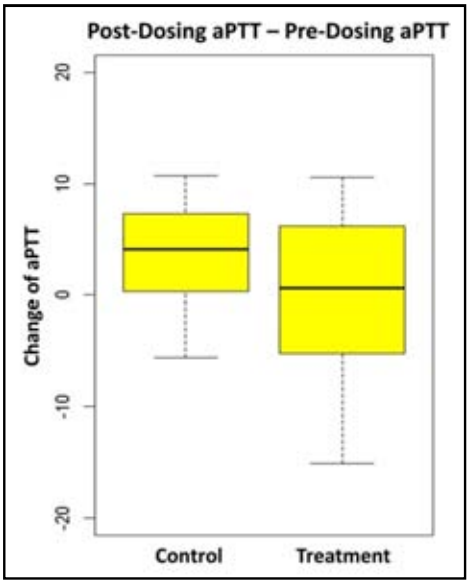

Figure 2: Distribution of activated prothrombin time change in each of the study groups.

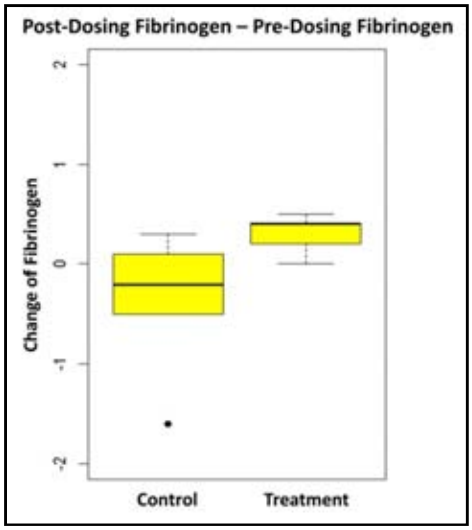

Figure 3: Distribution of fibrinogen change in each of the study groups. Note that, in the Control group, the small circle outside the box is an outlier, identified when the value is smaller than (Q1-1.5×IQR), where IQR = Q3-Q1.

Coagulation factors, namely aPTT, PT, and fibrinogen, were also of interest in the study patients undergoing surgery. Prothrombin time measures the extrinsic and common clotting pathways, and aPTT is an indicator of the intrinsic and common clotting pathways.[15] A significant trend was observed on aPTT changes in the study patients. This finding is relevant as Lanza et al. found that clinically normal appearing dogs who, however, are seropositive for *E. canis* and *A. platys* tend to bleed/ooze more during sterilization procedures. Their study did not find significant changes in PT and aPTT. The authors suggest these results may indicate that the normal battery of coagulation parameters are not effective in detecting a low-grade vasculitis contributing to the bleeding tendencies in these patients.[2] Moreover, the significant fact that aPTT changes (intrinsic coagulation pathway) are influenced by a patient's seropositive status to *E. canis* may help explain why these dogs bleed/ooze more during routine elective spays and neuters. The trend demonstrated in the present study, although not significant, points to the possibility that YB treatment may be beneficial in keeping aPTT values nearly unchanged.

Fibrinogen is an acute phase protein which plays a part in the inflammatory and coagulation processes.[16] Although fibrinogen levels have not been widely measured in dogs pre-operatively due to the consideration that they are more predictive of inflammation than coagulation competence, several human studies have shed a new light on this. A study by Walden et. al. compared fibrinogen levels, which ranged between low to high normal reference range, in 2000 patients prior to cardiac surgery and found an inverse relationship to bleeding during surgery (i.e. the lower the pre-operative fibrinogen, the more blood loss was recorded). The authors note that although fibrinogen is mostly considered as an acute phase/inflammation marker; they suggest that fibrinogen concentration prior to surgery may be more important than previously thought.[17] In the present study, fibrinogen remained nearly unchanged in the untreated controls (mean±SD change = -0.35±0.67). The YB treated dogs, however, demonstrated a 12.4% increase.

Study limitations stemmed from the logistics of the running of the JSAL. These labs involve many individuals performing different roles which creates variability. The admission and recruitment of patients for the study went well, however, the short time allotted to obtain the desired number of good surgical seropositive candidates was

Table 3: Individual and group coagulation parameters for Control Group dogs at baseline (Tuesday afternoon prior to surgery) and after 3 placebo doses (Tuesday pm, Wednesday am, Wednesday pm) on surgery morning post anesthetic induction (Thursday morning).

Dog Number	**PT** Baseline	Surgery am	**aPTT** Baseline	Surgery am	**Fibrinogen** Baseline	Surgery am	**Blood Loss** During Surgery
C/1	16.5	15.7	90.4	95.8	3.2	3.3	1.1
C/2	16.5	16.2	92.7	103.4	3.4	2.9	18.4
C/3	18.5	17.2	92.9	87.3	2.3	2.2	4.7
C/4	17.0	16.4	89.9	92.7	7.4	5.8	3.7
C/5	18.6	17.1	94.5	94.8	2.3	2.0	1.0
C/6	17.3	16.4	85.0	92.3	3.1	3.4	10.7
Group Mean±SD	17.4±0.94	16.5±0.57	90.9±3.35	94.4±5.31	3.62±1.91	3.27±1.36	6.60±6.78

Table 4: Individual and group coagulation parameters for Treatment Groups dogs at baseline (Tuesday afternoon prior to surgery) and after 3 doses of *Yunnan Baiyao* on surgery morning post anesthetic induction (Thursday morning).

Dog Number	**PT** Baseline	Surgery am	**aPTT** Baseline	Surgery am	**Fibrinogen** Baseline	Surgery am	**Blood Loss** During Surgery
T/1	17.2	16.8	85.2	80.0	3.9	3.9	2.4
T/2	16.2	17.4	99.3	99.0	3.2	3.6	4.1
T/3	17.4	16.5	89.4	95.6	2.2	2.6	3.9
T/4	17.0	17.0	84.2	85.7	1.7	1.9	11.9
T/5	17.1	17.3	77.2	87.8	2.5	2.9	9.1
T/6	18.0	17.1	104.3	89.2	2.0	2.5	7.2
Group Mean±SD	17.2±0.59	17.0±0.33	89.9±10.1	89.6±6.86	2.58±0.82	2.90±0.74	6.43±3.63

Table 5: Summary statistics on PT, aPPT, Fibrinogen, and Blood loss outcomes

		Pre-treatment (mean±SD)	**Post-treatment** (mean±SD)	**Change** (%; mean±SD; p-value)
PT	Control	17.4±0.94	16.5±0.57	-5.17%; -0.90±0.44; $p = 0.031$
	Treatment	17.2±0.59	17.0±0.33	-0.76%; -0.13±0.79; $p = 0.750$
aPTT	Control	90.9±3.35	94.4±5.31	+3.83%; +3.48±5.72; $p = 0.219$
	Treatment	89.9±10.1	89.6±6.86	-0.42%; -0.38±9.02; $p = 1.000$
Fibrinogen	Control	3.62±1.91	3.27±1.36	-9.67%; -0.35±0.67; $p = 0.344$
	Treatment	2.58±0.82	2.90±0.74	+12.4%; +0.32±0.18; $p = 0.063$
Blood Loss	Control		6.60±6.78	
	Treatment		6.43±3.63	

problematic. Any patient who arrived after Tuesday evening would not receive the three doses of placebo or YB and therefore was ineligible for the study. This directly affected the number of patients recruited to fill study groups within the time frame for data collection. In addition, the logistics to obtain blood samples before premedication of patients were not ideal at the time of data collection. Consequently, the post-dosing blood sample collection for evaluating the coagulation parameters had to be performed the morning of surgery after the dogs had been premedicated. The results might have been affected by unknown effects any of the premedication drugs may have on the mechanism of action of YB. To minimize the impact of this limitation, all blood samples were collected on both groups of dogs after premedication and processed in the same manner.

The reduced blood loss trend (3% of body weight) associated with YB treatment was small and did not achieve statistical significance in this study. The outcome of estimated blood loss may have been affected by the variation among students and instructors (a total of 4 students and 1 instructor per patient) participating in the surgical procedure. The subjective nature of estimating blood loss among different individuals by adding the number of used gauze sponges during the procedure and estimating the gauze blood saturation is not exact and probably prone to estimation error. This method also did not include the blood loss from surgical quarter/over drapes, surgical instruments/tray and surgeon gowns/gloves.

Taking into consideration the study limitations defined by this pilot study, a new clinical trial protocol is proposed. The clinical trial will span from 6 months to 1 year to ensure that a larger sample size is successfully attained. Oral administration of YB doses of 0.5g/5kg every twelve hours with the last dose before the surgery is recommended. Not dosing the study dogs on the morning of the surgery very likely diluted beneficial effects associated with YB administration as it has been shown that the herbal medicine has its greatest effects 3 hours after administration.[14] The premedication factor will be removed, and sample collection will occur upon admission to the lab, and after the surgical procedure. Additionally, a more objective method of estimating blood loss may involve weighing the gauze sponges used for hemostasis during surgery and comparing to the same number of clean gauze sponges, a modified method of estimating blood loss used in Liu's study.[12] A CBC and coagulation tests (buccal mucosal bleeding time, aPTT, PT, fibrinogen) will be collected upon admission and after the surgical procedure. Attention to platelet numbers will be emphasized since excessive bleeding due to coagulopathies (i.e., thrombocytopenia) is a concern in *E. canis* and *A. platys* seropositive dogs.[18]

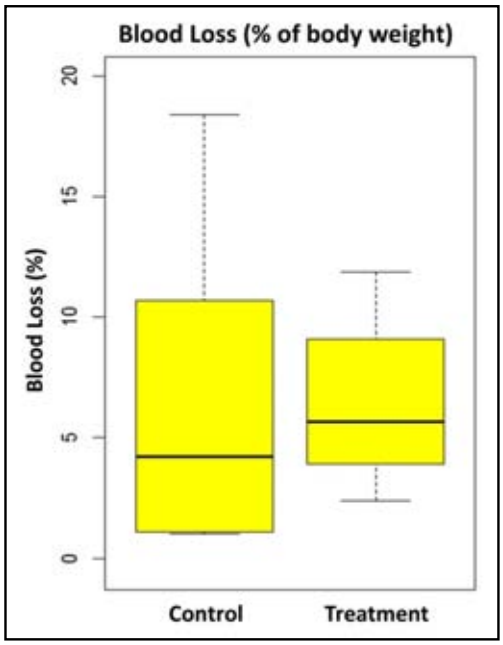

Figure 4: Distribution of blood loss in each of the study groups.

Based on evidence from the literature and this study, more robust studies are necessary to establish the effectiveness of preoperative oral administration of YB on tick-borne disease seropositive patient hemostasis. Important goals for these studies should include evaluating its effect on blood loss, coagulation parameters, platelet numbers and YB's anti-inflammatory properties. Finally, it will be important to establish an effective dose and timing for administration whereby this Chinese herbal medicine can be optimized for its intended purpose.

ACKNOWLEDGEMENTS

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Conflict of Interest and Funding

Supported in part by grants received from St George's University and Jing Tang Herbal. The authors declare there was no conflict of interest that could be perceived as prejudicing the impartiality of the research or writing of the paper for this study.

FOOTNOTES

a. SNAP 4Dx© Plus Test. IDEXX, Westbrook, ME USA
b. *Yunnan Baiyao*, 0.25g capsules-16-pack. Jing Tang Herbal, Ocala, FL USA
c. Greenies Pill Pockets, The Nutro Company, Franklin, TN USA
d. 3cc-22g syringe-needle combination, Bectin Dickenson (BD) & Co. Franklin Lakes, TN USA
e. VetScan® VSPro Coagulation Analyzer, Zoetis, Parsippany-Troy, NJ USA
f. R (version 3.5.2; 2018-12-20), The R Foundation for Statistical Computing, Vienna Austria

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Comparison of High Intensity Laser Stimulation of Acupuncture Points and Therapeutic Ultrasound for Relief of Chronic Lower Back Pain in Horses

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ABSTRACT

Chronic lower back pain is an important cause of decreased performance in sport horses. It can be a complicated diagnosis to make and once identified difficult to treat. The objective of this study was to compare the efficacy of treatment between high intensity laser stimulation of acupuncture points and therapeutic ultrasound in 28 sport horses with chronic low back pain. Horses diagnosed with chronic lower back pain were randomized into 2 treatment groups: high intensity laser stimulation of acupuncture points (HILSA) or therapeutic ultrasound (TU) applied to the lower back (T-18 to sacroiliac joint). The horses received a total of 8 treatments administered every other day during the study period (16 days). The reduction of pain between baseline (Day 0) and after treatment (Day 16) was evaluated both by TCVM acupoint sensitivity scan and pressure algometer. The acupoint sensitivity scan demonstrated statistically significant improvement for both treatment modalities. The HILSA Group change (8.13 ± 8.476) was very significant (p=0.0028) with a 66% change from baseline while the TU Group change (3.77 ± 4.38) was also significant (p=0.0223) with a 34% change from baseline. Comparison of the magnitude of improvement between groups was not statistically significant (p=0.0659). Algometer measurements experienced some limitations with inconsistent results. It can be concluded from study findings that both treatment modalities are associated with a statistically significant reduction of lower back pain in sport horses and selection of treatment can be based on the advantages and disadvantages of each modality dependent on the patient and situation.

Keywords: back pain, therapeutic ultrasound, sport horse, laser acupuncture, high intensity laser

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ABBREVIATIONS

HILSA	High intensity laser stimulation acupoints
LAP	Laser acupuncture
NSAIDs	Non-steroidal anti-inflammatory drugs
TCVM	Traditional Chinese veterinary medicine
TU	Therapeutic ultrasound

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Lower back pain is a common health problem in the horse.[1] It can result in chronic pain with gait altering consequences that limit performance and impair ability to work which constitutes a common concern for equine veterinarians working on performance horses.[1,2] There is increasing interest both in diagnostic methods to enable the recognition of back pain in a horse as the source of poor performance as well as developing therapeutic modalities to manage this clinical disease.[2]

The horse is designed to move in a forward direction at speed, therefore, when asked to perform movements other than this (e.g. jumping, lateral movements), the muscles of the back are prone to injury.[2] Assessment of low back pain in the horse centers on the area from T-18 to the sacroiliac joint.[2] Surveys of equine veterinarians have demonstrated that there is a lack of a tailored diagnostic workflow and consolidated therapeutic approach to pain in this anatomic region of the horse.[1] The types of treatment modalities are many and varied

with a sampling including: non-steroidal anti-inflammatory drugs (NSAIDs), vertebral articular facet injection, acupuncture, laser therapy and therapeutic ultrasound.[1,3-10]

Acupuncture, laser therapy and therapeutic ultrasound have been receiving increased interest from equine veterinarians.[1,2] Acupuncture, in particular, has received publicity and notoriety over the past 20 years in both human and veterinary medicine. The insertion of needles into specific parts of the body has been shown to provide analgesic and therapeutic effects.[11] It has become a popular alternative therapy for the alleviation of chronic lower back pain particularly when drugs are not desired or ineffective and its use in horses continues to increase.[9,12] There are some limited challenges in its use in horses with back pain. Some individuals have a strong dislike for needles placed anywhere on their bodies and can particularly overreact to needles placed in painful anatomic sites. This can lead to a dangerous situation for the veterinarian and limit optimal treatment. A variation of this therapy is to use laser stimulation of acupuncture points. This acupuncture technique to treat chronic low back pain in horses has advantages over other forms of acupuncture in that it is easy to perform, lacks pain during treatment which simplifies restraint and avoids complications from needle puncture (e.g. infection, broken needles).[13] In addition, laser stimulation of acupuncture points is proving to be an efficacious treatment for chronic back pain in horses.[9]

Table 1: Definition of each back pain grade assigned to study horses used to equally distribute the horses according to back pain level between the 2 study groups.

Grade	Definition
Mild	Mean pressure tolerance at trigger point higher than 6.5 lbs/cm^2 with mild muscle spasms when TCVM acupoint sensitivity palpation performed
Moderate	Mean pressure tolerance at trigger point higher than 6.5 lbs/cm^2 with obvious muscle spasms when TCVM acupoint sensitivity palpation performed
Severe	Mean pressure tolerance at trigger point below 6.5 lbs/cm^2 and obvious muscle spasms with trying to avoid the needle cap, grind teeth, bite or kick when TCVM acupoint sensitivity palpation performed
Profound	Mean pressure tolerance at trigger point below 6.5 lbs/cm^2 and severe long lasting muscle spasms with avoidance of the needle cap, grind teeth, bite or kick when TCVM acupoint sensitivity palpation performed

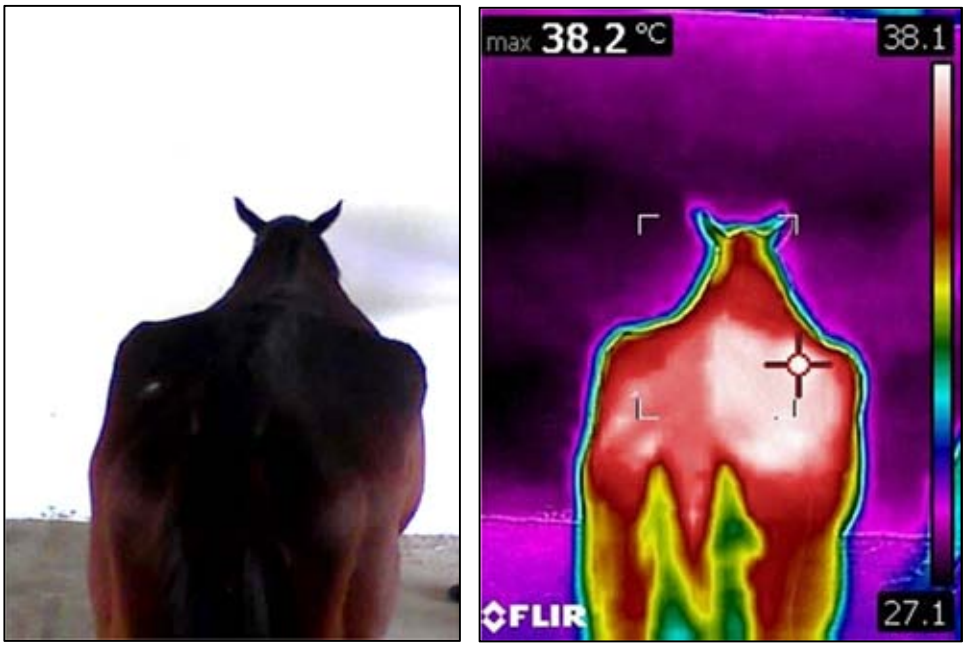

Figure 1: Caudal view of a horse's back before thermography evaluation (left) and the infrared image view (right). The infrared view shows higher temperature on the right side of the back.

Therapeutic ultrasound (TU) is a widely used treatment for musculoskeletal pain in many species. It is a comforting, mildly heating, noninvasive modality used for promotion of tissue repair or prior to stretching of tight or adhered structures.[10] It is regularly used in human physical therapy. Sound waves are absorbed preferentially by collagen rich connective tissues such as ligaments, tendons, fascia and scar tissue. It has proved beneficial for treating tendon/ligament injuries, muscle spasms, joint swelling and mild arthritis.[10] Therapeutic ultrasound (1-3 MHz) is not to be confused with diagnostic ultrasound which operates at higher frequencies (3-7 MHz). Therapeutic ultrasound is the deepest source of heat available, penetrating 5-6 cm deep into tissues. This therapy can be very useful for back pain, especially for large muscle spasms and deeper scar tissue causing pain in the horse.[14] Although ultrasound is considered relatively safe, contraindications include unacceptable temperature increases in the target area with damage to tissue. Unlike ultrasound use on humans where pain from the therapy can be expressed, veterinary practitioners must be attuned to pain behavior exhibited by the horse to avoid tissue injury.

The objective of the present study was to investigate the efficacy of laser acupuncture and therapeutic ultrasound treatment for equine lower back pain relief by measuring pressure algometer change at trigger points and traditional Chinese veterinary medicine (TCVM) acupoint sensitivity scans. The research question around which the design of this study was focused asked which treatment modality is more effective in providing pain relief for sport horses with chronic lower back pain. The study was approved by the Animal Welfare Committee of the Veterinary Medicine Faculty, Chiang Mai University and owners supplied informed consent for horses to participate in the study.

MATERIALS AND METHODS

The population of sport horses considered for enrollment in this study were housed at the Polo Park, Pattaya, Thailand (Barn A) and the Riding Club, Chiang Mai, Thailand (Barn B). Horses from these 2 stables were evaluated for chronic back pain. The criteria for inclusion of a horse in the study was a history of poor performance for at least 3 months, no analgesic/anti-inflammatory medications for 2 weeks prior to evaluation for study enrollment (e.g. glucocorticoids, NSAIDs) and positive for low back pain. A veterinary lameness examination to identify horses with back pain included a computerized lameness analysis[a] program; back palpation using a pressure algometer[b] at trigger points (5-11 lbs/cm^2); positive traditional Chinese veterinary medicine (TCVM) acupoint scan and reduced thoracolumbar flexibility. Exclusion criteria included any of the following: non-weight bearing lameness, hoof abscess (identified by hoof percussion test), medical treatment within 2 weeks before or during the study, poor behavior (refusal to stand in a stall/stock for treatment), an accident occurring during the study or thermographic camera[c] screening identifying acute inflammation on the body or limbs (Figure 1). After diagnosis of chronic low back pain, horses were divided into 4 back pain severity levels: mild, moderate, severe and profound (Table 1). The lameness examination was recorded by video camera[d].

Figure 2: An experienced physiotherapist evaluating pain threshold levels at trigger points using a pressure algometer.

Once a horse met inclusion criteria, the animal was enrolled in the study in a randomized order with equal distribution of horses within a back-pain level between the 2 treatment groups: high intensity laser stimulation of acupuncture points (HILSA) or therapeutic ultrasound (TU). In addition, horses in Barn A were randomly assigned to either the HILSA or TU groups, as were horses located in Barn B. All study horses underwent a standardized battery of exams to collect outcome data at baseline (Day 0) and one more time after 8 treatments spaced every other day (Day 16).

On Day 0 and Day 16, a clinical exam was performed which included an acupoint scan of the Bladder Meridian by applying even pressure with a blunt object (hypodermic needle cap) along the meridian and scoring from 0-3. The "0" score was no response to pressure, "1" a mild muscle spasm, "2" a strong muscle spasm and "3" a very severe spasm with marked avoidance behavior by the horse. The most painful point (trigger point) during the clinical exam (Day 0) was identified and marked (clipped hair). An experienced physiotherapist (PR) evaluated the level of pain at the trigger point (both sides) using a pressure algometer[b] (measures 1 to 22 lbs/cm^2) pressed perpendicular to the trigger point (Figure 2). The scale was read at eye level when the horse showed signs of pain or muscle contraction. Measurements were performed four times with 15 seconds of rest between measurements. Data from the first measurement was discarded. The mean measurement of pain pressure from each side of the back was then calculated from the three measurements. A lower algometer score indicated increased pain while the higher score indicated less pain. The trigger point was assessed again on Day 16 by algometer measurement (study termination).

Treatment of the HILSA study group horses consisted of laser stimulation of selected acupuncture points with a Class 4 high intensity laser unit[e,f] (Tables 2 and 3). Preparation of the area consisted of application of ice for 15 seconds to an area which had the hair clipped marking the acupuncture point (Figure 3). Ice was applied to elicit local vasoconstriction (limit photon

Table 2: Acupuncture points used to treat lower back pain in sport horses.[16]

Acupuncture points	Indications and Actions
BL-21	Back-*shu* association point for ST, promote GI motility, relieve colic pain; diarrhea, colic, constipation, vomiting
BL-23	Back-*shu* association point for KID; urinary incontinence, impotence, edema, ear problems, back pain
BL-25	Back-*shu* association point for LI; diarrhea, constipation, back pain, abdominal pain
BL-26	Gates of *Yuan*-source *Qi*; impotence, urinary incontinence, diarrhea, abdominal pain
Bai-hui	Hind quarter pain, hind quarter paralysis, hip arthritis, contusion, colic, gaseous bowel, diarrhea, wind pattern, *Yang* deficiency, overexertion

ST=Stomach, KID=Kidney, LI=Large intestine

Table 3: Laser irradiation parameters of the high intensity lasers used to stimulate acupuncture points in study horses.

High Intensity Laser Parameters	
Medium	Solid-state: diode
Wavelength	980, 810 nm
Frequency	1 MHz (continuous wave)
Energy Output	1W or 2W
Power Density	1 - 2 W/cm2
Energy Density	12 J/cm2
Time/acupuncture point	12 seconds at 1W or 6 seconds at 2W
Total Joules/acupuncture point	12 J
Spot Size	10 mm (Diameter)
Total Number of Acupuncture Points Used	4 bilateral acupuncture points and *Bai-hui*

absorption by melanin, hemoglobin, oxyhemoglobin chromophores) to allow maximum tissue penetration of laser photonic energy.[15] Acupuncture point stimulation protocol (laser company[e,f] recommended) consisted of applying the laser probe at 1watt (W) energy output with a duration of 12 seconds per acupuncture point or 2W (duration 6 sec per acupoint). Both protocols, which were identical for both lasers, gave the same total dose of laser energy (12 Joules per acupoint) and energy density of 12 J/cm^2, however, the 1W (12 second) duration was recommended by the company representatives to avoid thermal injury (Table 3). During the study, one laser[e] was used in Barn A and the other laser[f] was used in Barn B, with both laser companies supplying the same laser protocols. The acupuncture points treated were BL-21, BL-23, BL-25, BL-26 bilaterally and *Bai-hui* (Figure 3, Table 2).[16] These acupoints were stimulated in all study horses in this group and were chosen because their locations would be proximal, distal and at the site of any painful lumbar area in a horse.[9] In TCVM, acupoints distal to *Qi*-Blood Stagnation (pain) should be included to increase *Qi* flow.[5] Each horse received treatment every other day for 16 days (8 treatments). Between treatment sessions, exercise programs were not controlled.

Figure 3: A study horse's lower back prepared for a laser acupuncture treatment (left). Note shaved areas starting at the most proximal aspect: BL-21, BL-23, BL-25, BL-26 and *Bai-hui.* Laser stimulation of an acupuncture point with the high intensity laser is demonstrated in the right picture.

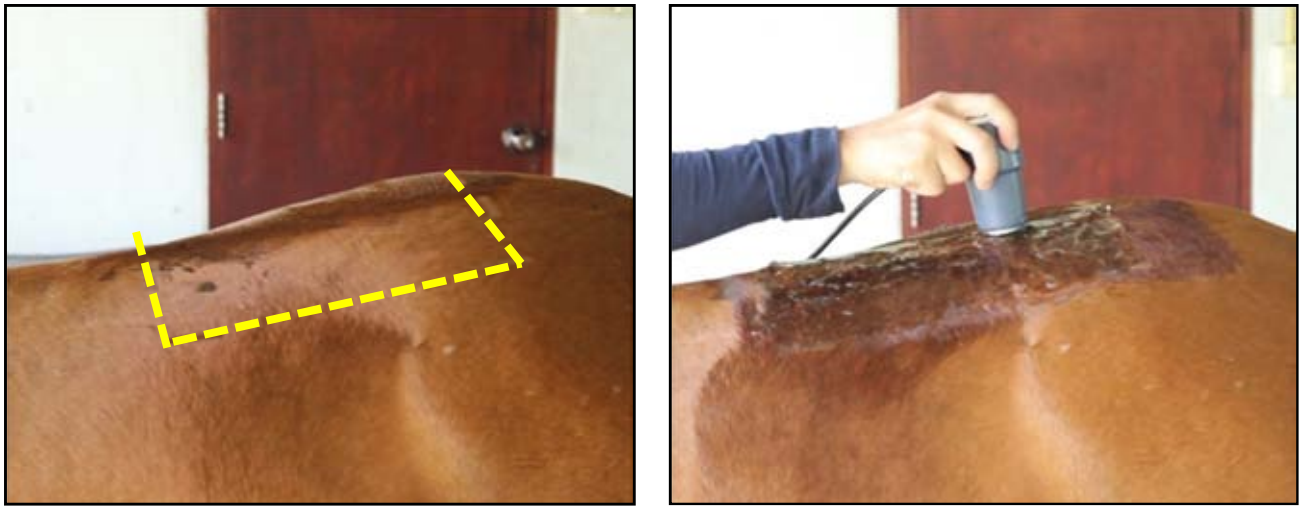

Figure 4: Study horses were prepared for ultrasound treatment by clipping the hair along both sides of the spine (10 cm width) beginning at the last rib extending to the sacroiliac joint (left picture). Before each treatment this area was brushed off, scrubbed with soap, rinsed and then alcohol sprayed over the area before starting treatment with the probe (right picture).

The treatment protocol for the TU group was calculated following the guideline for therapeutic ultrasound.[17] The ultrasound unit[g] power output was set at 2W/cm^2, 1 MHz frequency (continuous pulse), 25 minutes per side duration, probe size of 12.56 cm^2 or power output 2 W/cm^2, 1 MHz frequency (continuous pulse), 20 minutes per side duration and probe size of 19.63 cm^2. The treatment area was prepared before therapy by clipping the hair along both sides of the spine (10 cm width) beginning at the last rib extending to the sacroiliac joint (Figure 4). Each horse received treatment every other day for 16 days (8 treatments). Before each treatment the area was brushed off, scrubbed with soap, rinsed and then alcohol sprayed over the area before starting treatment with the probe. Similar to the laser acupuncture group, the ultrasound group did not have a controlled exercise program between treatments.

Outcome data was determined by 2 measurements: algometer readings at trigger points and TCVM acupoint sensitivity scans. The algometer measurement of trigger point sensitivity was collected pre-treatment (Day 0) and compared to post-treatment (Day 16) for improvement. Data from the 2 groups were compared both for difference before and after treatment within group and back pain improvement after treatment between the 2 study groups (HILSA vs TU). A clinical assessment measurement (acupoint sensitivity scan) was included. Similar to the algometer measurements, acupoint sensitivity change was compared between pre- and post-treatment within a group and then between study groups (HILSA vs TU) for back pain improvement. Paired t-test was used on all parametric data statistical evaluation and the Mann-Whitney U test for non-parametric data[h]. In both analyses, $p<0.05$ was considered significant. Sample size was calculated by a commercial statistical software[h] which generated a population requirement of 20 horses divided into 2 groups.

RESULTS

A total of 50 sport horses from 2 stables were screened for participation in this study. After being evaluated for study inclusion criteria, a final 31 sport horses diagnosed with chronic lower back pain were enrolled. During the study, 3 sport horses were excluded due to medical incidents which caused them to be unable to continue participation in the study. A final 28 horses completed the study. Signalment for study horses included 10 Argentine polo ponies, 2 Thoroughbreds, 10 mixed breeds and 6 ponies with a mean ± SD age of 9.33 ± 3.9 (range 5-16) years. Sex and riding discipline for the study animals included 20 geldings, 1 stallion and 7 mares used as polo sport horses (10/28), jumpers (9/28) and riding horses (9/28). Back pain levels of these horses when they qualified for the study included 6 horses with mild pain, 8 horses as moderate, 11 severe and 3 with profound pain. The horses were randomized into 2 treatment groups with equal distribution of pain levels through the 2 groups and equal distribution between the 2 participating barns (Barn A, Barn B). The HILSA Group (n=15) was treated with high intensity laser at 9 acupuncture points and the TU Group (n=13) received therapeutic ultrasound treatment along the lower back area (T-18 to sacroiliac joints).

The clinical outcome measurement (acupoint sensitivity scan) in the HILSA Group was very statistically significant (p=0.0028) with a mean ±SD difference between pre- and post-treatment of 8.13 ± 8.476 (66% change from baseline) while the TU Group had a statistically significant (p=0.0223) mean difference of 3.77 ± 4.38 (34% change from baseline) (Table 4). The findings for outcome data of pain assessment (pressure algometer measurement) in the HILSA Group when comparing pre- and post-treatment findings demonstrated a mean ± SD difference of 0.657 ± 1.848 (Table 5). The TU Group demonstrated a mean difference of -0.096 ± 1.87.

Table 4: Pre-test versus post-test comparison within a study group for acupuncture point sensitivity scan measured at Day 0 and Day 16 (study completion). Decreased sensitivity scores indicate less pain. Statistical evaluation Wilcoxon (pre-treatment and post-treatment)

Acupuncture Point Sensitivity Scan	High Intensity Laser Acupuncture (rounded value)	Therapeutic Ultrasound (rounded value)
Pre-Treatment	12.3±8.08	11.00±9.005
Post-Treatment	4.17±4.704	7.23±7.18
Difference Pre- versus Post-Treatment	8.13±8.476	3.77±4.38
Percent Change	66.09% (66%) Improved (less pain)	34.27% (34%) Improved (less pain)
p-value	0.0028**	0.0223*

*statistical significance $p<0.05$; **statistical significance $p<0.01$

Table 5: Pre-test versus post-test comparison within a study group for trigger point sensitivity measured by a pressure algometer at Day 0 and Day 16 (study completion). Increased algometer measurement reading indicates less pain at the trigger point. Statistical evaluation paired t-test (pre-treatment and post-treatment).

Algometer Measurement	High Intensity Laser Acupuncture (rounded value)	Therapeutic Ultrasound (rounded value)
Pre-Treatment	8.258±3.172	6.779±2.102
Post-Treatment	8.915±3.214	6.683±1.802
Difference Pre- versus Post-Treatment	0.657±1.848 (0.66±1.85)	-0.096±1.87 (-0.1±1.87)
Percent Change	7.95% (8%) Improved	-1.4% (-1%) No improvement
p-value	0.1651	0.8135

*statistical significance $p<0.05$; **statistical significance $p<0.01$

Table 6: Comparison between groups (HILSA vs TU) for algometer measurement and acupoint sensitivity change for pre-treatment versus post-treatment.

	High Intensity Laser (HILSA)	Therapeutic Ultrasound (TU)	Comparison of change between groups *p*-value
Change between pre-study and post-study acupoint sensitivity scan	8.13±8.476	3.77±4.38	0.0659 (Mann-Whitney U test)
Change between pre-study and post-study algometer measure	0.657±1.848	-0.096±1.87	0.2244 (t-test method)

*statistical significance $p<0.05$; **statistical significance $p<0.01$

Comparison of the magnitude of change from baseline to study termination (Day 16) was compared between the two study groups (HILSA versus TU). Using TCVM acupoint sensitivity scan the change for HILSA was 8.13±8.476 which when compared to the change for TU treatment (3.77±4.38) was not statistically significant (p=0.0659). Comparison of the change in algometer measurement between the two groups (0.657±1.848 HILSA versus -0.096±1.87 TU) was not statistically significant (p=0.2244) (Table 6).

The data was calculated as mean score of pain on each side from TCVM acupoint sensitivity scan (TCVM) and pressure algometer tolerance. All data were expressed as mean ± SD. The designation "N" was equal to number of sides that showed pain. Paired t-test was used to determine the difference between before and after treatment within the same group and to determine mean difference before and after treatment between the HILSA Group and TU Group for pressure algometer tolerance as they exhibited normal distribution. The Wilcoxon test was used for acupoint sensitivity scan (TCVM) on each side as it didn't exhibit normal distribution.

The only adverse event associated with experimental treatments during the study was mild thermal injury (transient swelling, skin scurf/flaking at site) from the first high intensity laser setting (2W for 6 seconds) at the first acupuncture session. Consultation with the laser company recommended an adjusted setting (1W for 12 seconds) which was adopted with no further incidents for the rest of the study.

DISCUSSION

Conventional treatment for chronic low back pain in horses commonly uses a combination of anti-inflammatory drugs and rest, however, alternative treatments such as laser acupuncture and therapeutic ultrasound are garnering increased interest as treatment modalities. In this study, a research question was posed as to whether one alternative treatment modality is better than the other when treating sport horses with chronic lower back pain. Twenty-eight horses with chronic low back pain completed the study receiving either high intensity laser

acupuncture treatment or therapeutic ultrasound. Pain relief was measured by both TCVM acupoint sensitivity scan and pressure algometer at trigger points. Both groups demonstrated statistically significant pre- versus post-treatment back pain improvement as measured by acupoint sensitivity scan (HILSA 66% change from baseline, p=0.0028 and TU 34% change from baseline, p=0.0223). The magnitude of change was not large enough to show a statistically significant difference between groups (p=0.0659). The study findings suggest both treatments are effective with laser acupuncture demonstrating a small non-statistical greater effect on back pain relief under the experimental conditions of this study.

Algometer use in this study had unexpected difficulties which were reflected by inconsistent results. There were dual issues with both the examiner having difficulty maintaining the Fischer's recommended rate of pressure increase of 1 kg/cm^2/s (slow examiner reaction time with nonelectrical algometer) and study horses contracting their back during the measurement.[18,19] The slow examiner reaction time most likely created a trend which produced higher rates of pressure increase. This is reflected in the research findings for this study which noted a range of 5-11 lbs/cm^2 which is higher than the algometer measured 2.67-4.5 lbs/cm^2 for equine back pain reported in a recent study.[2] It is proposed that the higher algometer pain tolerance level in the current study horses was due to the thicker loin muscle bundle (lumbosacral area) used to record algometer measurements versus the thinner withers area which was measured in the former study due to more cranial saddle area pain.[2] It is likely these issues affected the ability of this measurement to accurately and objectively detect back pain changes in the present study horses.

Although no studies were found comparing high intensity laser acupuncture to ultrasound for chronic back pain in horses or humans, there was a study that compared successful treatment using low intensity laser acupoint stimulation for treatment of chronic back pain in horses. The low intensity laser (300mW, 904nm wavelength) was applied for 2 minutes (versus 12 seconds in the present study with high intensity laser) to acupuncture points in 14 horses with chronic back pain for 11 treatments. The authors reported clinical signs of back pain were alleviated in 10 of the 14 horses, there was no change in three, and one was lost to follow-up. Of the 10 horses who were training and competing, four won. One year after treatment was discontinued, 9 of these 10 horses continued to perform at a standard acceptable to the owner.[9]

The use of photonic energy provided by a laser to stimulate acupuncture points in the horse requires high enough energy to penetrate tissue to the average depth of needle acupuncture along with skin safety.[20,21] The development of new technologies in recent years has allowed the invention of therapeutic laser devices with much higher energy output. The Class IV lasers, (>500 mW), ranging to 25W or higher are currently applied not only in surgery but also in laser therapy (i.e. high intensity laser therapy). This technology (Class IV laser) was selected to investigate efficacy in this study as it considerably shortens treatment times, as well as provides adequate photonic energy to stimulate to the tissue depth needed for equine acupuncture points.

The effects of laser therapy at the cellular level have been well described and include stimulation of mitochondrial activity, stimulation of RNA and DNA synthesis, variation of intracellular and extracellular pH, increasing cell metabolism with increased protein production and modulation of enzymatic activity.[22] In contrast to the therapeutic use of lasers where light affects the metabolic processes of target cells (photobiomodulation), laser acupuncture (LAP) is reported to affect neural response in the same way as needle acupuncture.[22] It appears to work by suppressing pain using neurological and humoral mechanisms, similar to needles.[22] In humans, several functional magnetic resonance imaging (MRI)-based analyses have demonstrated comparable cerebral activity patterns when LAP is compared to needle acupuncture.[23-25] Additional comparative studies have noted needle stimulation acts as an exponential peak with quick return to baseline whereas laser stimulation is more plateau-like with a lower peak but longer duration.[26]

Limitations to optimal conduct of this study included the inability to effectively blind investigators because of shaved hair coat patterns (acupuncture sites and bilateral ultrasound sites) which could create bias. Exercise was not controlled for the study horses due to creating economic loss for owners who had horses participating in the study. The lack of similar exercise patterns for all horses could have created additional injury in some horses which might affect study outcome. This problem was addressed by observing study horses closely and any horses with recognizable injury were dropped from the study. This caused a decrease from 31 horses that started the study to 28 horses that completed the study.

An unexpected adverse side effect, thermal injury, occurred during the study when the HILSA Group was treated using a protocol of 2W for 6 seconds per acupuncture point. The lesions were characterized by a 1 cm area of hair loss with surface crusting with return to normal appearance in approximately 2 weeks. The commercial laser company suggestion to use a power of 1W with a duration 12 seconds per acupuncture point (12 J/cm^2) corrected the issue and no further adverse effects occurred.

When comparing the ease of each mode of treatment, the procedure was simpler for the HILSA Group. The only preparation for this group was placing an ice pack on each acupuncture point for 15 seconds prior to laser stimulation of an acupuncture point while in the TU group, preparation of the treatment area was lengthy. The TU application site had to be brushed off, cleaned and then sprayed with alcohol before the treatment could begin. Total treatment time was markedly longer in this group (20-25 minutes per side, total 40-50 minutes) versus HILSA (12 seconds per point, total 1.8 minutes).

Using high intensity laser acupuncture was practical for field use, whereas the therapeutic ultrasound was not. The one negative aspect of HILSA use was the significantly higher equipment acquisition cost when compared to TU.

In summary, high intensity laser acupuncture was compared to therapeutic ultrasound for the treatment of chronic lower back pain in horses over a period of 16 days encompassing 8 treatment sessions. Both treatment modalities were effective with a slight edge to laser acupuncture for ease of use in the field and greater pain relief (non-statistical significance) when compared to therapeutic ultrasound. The choice of treatment, therefore, for chronic lower back pain in horses should consider the advantages and disadvantages of each treatment modality as it applies to the individual patient and situation presented.

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FOOTNOTES

a. EquinosisTM, Equinosis, LLC, Columbia, MO, USA
b. Wagner Pain Test™ Model FPK Algometer, Wagner Instruments, Greenwich CT, USA
c. FLIR C3, FLIR Systemic, Inc., Oregon, USA
d. Panasonic HCV-180, Panasonic Corporation, Osaka, Japan
e. Companion Animal laser, Companion Animal Health, LiteCure, LLC, New Castle, DE, USA
f. BTL 6000 Laser, BTL Industries Ltd, Stevenage, Hertfordshire, United Kingdom
g. Enraf-Nonius Sonoplus 190, Enraf-Nonius B.V., Rotterdam, Netherlands
h. G*Power. Version 3.1.9.2 statistical software; Franz Faul, Universität. Kiel, Germany

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Review

Evidence-based Application of Acupuncture in Equine Practice

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ABSTRACT
Traditional Chinese Veterinary Medicine (TCVM) including acupuncture has been used to treat disease and relieve pain in horses for more than 2,000 years. A review of the current knowledge of the mechanisms of acupuncture stimulation is presented. An emphasis is placed on electro-acupuncture, which can release neurotransmitters such as 5-hydroxytryptamine (serotonin) and endogenous opioids including β-endorphin, to relieve pain. Acupuncture has been shown to be a viable integrative treatment for equine back pain, foot pain, cervical stiffness, laryngeal hemiplegia and infertility. Acupoint sensitivity on palpation may be useful for the assessment of lameness along with conventional diagnostics in horses. Future well-designed studies are needed in order to strengthen the recommendation for acupuncture in the diagnosis and treatment of clinical conditions in horses.

Keywords: acupuncture, electro-acupuncture, review, equine, pain relief, clinical practice

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ABBREVIATIONS

5-HT	5-hydroxytryptamine
ACTH	Adrenocorticotropic hormone
AP	Acupuncture points
Aqua-AP	Aqua-acupuncture
BHSL	Back half stride length
DFB	Difference front/ back
DNAP	Dry needle acupuncture
EAA	Electro-acupuncture analgesia
EAP	Electro-acupuncture
FHSL	Front half stride length
f-MRI	Functional-magnetic resonance imaging
HR	Heart rate
HWRL	Hoof withdrawal reflex latency
IA	Intra-articular
LH	Laryngeal hemiplegia
MPJP	Metacarpal-phalangeal joint pathology
MSC	Mesenchymal stem cells
NPV	Negative predictive value
PO	Per os
PPV	Positive predictive value
TCVM	Traditional Chinese veterinary medicine
TPS	Thoracolumbar pain score
TSL	Total stride length

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Traditional Chinese Veterinary Medicine (TCVM) including acupuncture has been used to treat disease and relieve pain in horses for more than 2,000 years.[1-2] As the use of acupuncture has increased over the past few decades in countries where modern Western medicine is the foundation of health care, there has been increasing scientific effort to evaluate this ancient medical modality for objective evidence of efficacy.[3-7] This paper will review the basis of acupuncture and evidence-based clinical application of acupuncture in equine practice including diagnosis and treatment of lameness, pain management, reproductive and other diseases.

ACUPUNCTURE PROCEDURES

The top three acupuncture techniques used currently in veterinary medicine are dry needle (DNAP), aqua-acupuncture (Aqua-AP) and electro-acupuncture (EAP).

Dry Needle Technique

Dry needle (DNAP) is one of the earliest acupuncture techniques. In TCVM it is called "White Needle", *Bai-zhen* (no intentional bleeding). It is the most common acupuncture treatment modality in veterinary and human practice. It involves the insertion of thin sterile needles of certain gauges and lengths depending on species and location of acupoints.

Electro-acupuncture

Electro-acupuncture (EAP) is a growing and common adjunct to DNAP treatments. Historically clinical application of EAP began in China in the 1950's.

It has become common in veterinary practices, especially for analgesic purposes and other pain management.[8-9] Following placement and insertion of the acupuncture needles in appropriate acupoints, the application of a mild electrical current passed through the needles allows a repeatable, more consistent and prolonged therapeutic stimulation. The frequency and amplitude of the electrical current can be adjusted. A high versus low frequency has differing effects on systemic neuromodulation and the amplitude is adjusted to a stimulation threshold tolerated by the patient. There are a variety of EAP unit types available with the ultimate goal of strengthening and altering the needle stimulation. Lower frequency (around 20 Hz) EAP mediates endorphin release and is best for treating pain and muscle spasms. Higher frequency (80-120 Hz) is associated with 5-hydroxytryptamine (5-HT, serotonin) release and may be best to re-educate the motor neurons in paresis and paralysis.[8,10-11]

Aqua-acupuncture

Aqua-acupuncture (Aqua-AP) involves the injection of fluids and soluble products into acupuncture points. Sterile saline, vitamin B12, homeopathic remedies, the patient's own blood, and local anesthetics are most commonly used in Western acupuncture practice. It is used to lengthen and strengthen an acupuncture treatment or used when the patient will not remain calm long enough to keep filiform needles in place.[8] Injection of an animal's own blood has become common for injury, autoimmune and inflammatory disorders.

An interesting example of Aqua-AP is highlighted in a study where eight horses were randomly assigned to four different treatment protocols according to a Latin Square double-blind design in order to explore the clinical sedation effect of Aqua-AP: Group 1) 0.1 ml/kg of saline subcutaneously injected at the cervical region (negative control), Group 2) 0.1 mg/kg acepromazine injected subcutaneously cervical region (positive control, conventional dose), Group 3) 0.01 ml/kg of saline injected into acupoint GV-1 (Aqua-AP, 10% of negative control saline dose) and Group 4) 0.01 mg/kg acepromazine injected into acupoint GV-1 (Aqua AP, 10% dose acepromazine).[12] Signs of sedation were observed in Group 2 (full dose, positive control), Group 3 (Aqua-AP, 10% dose saline) and Group 4 (Aqua-AP, 10% dose acepromazine) at 30 minutes. Only in Group 4 was the sedation effect still present at 60 minutes after the injection. This study indicated that both acupoint injections (at only 10% of negative/positive controls) at GV-1 produced sedation, however, the diluted acepromazine (0.01 mg/kg) injection at GV-1 doubled the length of sedation (60 minutes) at only 10% acepromazine dose when compared to Group 2 full dose acepromazine (positive control).

ACUPUNCTURE POINT SENSITIVITY FOR EQUINE LAMENESS DIAGNOSIS

Digital palpation at key diagnostic acupuncture points for acupoint sensitivity was reported to be used for diagnosis of lameness in horses by American equine practitioners in the 1990's.[13-14] One study reported that out of 327 racing Thoroughbreds examined either for lameness or routine musculoskeletal evaluation, acupuncture point sensitivity diagnosis indicated metacarpophalangeal joint pathology (MPJP) was present in 176/327 (54%) of the affected horses. Of the 176 MPJP horses, 176 (100%) had sensitivity at acupoint LI-18, and 158 (90%) had sensitivity at acupoint SI-16.[15] In this group of horses, 111/176 (63%) were not lame. Of the 65/176 horses that were lame, 18 (27.7%) became sound after intra-articular injection (IA) of mepivcaine hydrochloride in the fetlock. The remaining 47 (72.3%) were lame as a result of extra-articular fetlock or non-fetlock pain.

In a different study, acupoint sensitivity was tested in several different groups of horses showing signs of hoof lameness with conventional diagnosis.[16] Sensitivity at LI-18 was found in 23/30 (77%) horses with chronic heel pain, 31/45 (69%) with acute heel pain and 24/29 (83%) horses with laminitis. Sensitivity at SI-16 was detected in 18/30 (60%) lame horses with chronic heel pain, 27/45 (60%) with acute heel pain and 11/29 (38%) with laminitis. No correlation of foot lameness with acupuncture point sensitivity was found in this study in cases of subsolar abscess, bruised feet, hoof cracks and painful wounds.

A total of 102 client-owned horses were presented for routine acupuncture, reduced performance or lameness.[17] Each horse first underwent a <2-minute screening scan of acupuncture points (AP) and was classified as positive or negative for acupoint sensitivity by the same veterinarian certified in veterinary acupuncture and experienced in performing AP scans and unaware of the presenting complaint in all cases. Each horse was then evaluated for lameness and categorized as lame or sound by a different veterinarian. In the sound group, 40/51 (78.4%) horses had a negative AP scan and 11/51 (21.6%) had a positive AP scan. In the lame group, 9/51 (17.6%) horses had a negative AP scan and 42/51 (82.4%) had a positive AP scan (p<0.001). Acupuncture scanning had a sensitivity of 82.4% to detect lameness and a specificity of 78.4%, with an accuracy of 80.4%. Significant but modest correlations existed between the side of the horse that was positive on the AP scan and the side of lameness. The conclusion of the study was that an AP scan could be a useful, quick screening tool during the physical examination to identify horses that should undergo a full lameness examination and other diagnostic testing.

A Brazilian group performed a soundness exam on 810 athletic horses involved in different disciplines because of poor performance, lameness, refusal to jump, upward fixation of the patella, thoracolumbar spine or sacroiliac pain, suspensory lesions and front hoof problems from 2001 through 2012.[18] They used acupuncture sensitivity on palpation and clinically diagnosed 86 (9.4%) horses with stifle syndrome.

Twenty-two (25.6%) of the 86 horses with stifle syndrome underwent ultrasonography and/or radiography, and lesions were detected in 21 (95.5%) animals. The diagnostic points for stifle syndrome included BL-20, BL-21, local stifle points (e.g. BL-37, 38, 39), GB-27, SP-13, ST-30, and the sacral acupuncture point BL-54. They concluded that acupuncture point sensitivity for diagnosis of stifle disease may be considered a reliable diagnostic method and suggested it be included in routine clinical examination of horses and in reference textbooks as a lameness diagnostic modality.

An equine practitioner from South Africa has reported identifying soft tissue injuries and pain in horses using diagnostic points associated with the Gallbladder Channel with good clinical results.[19-20] Finally, very recently Schmid and Aebischer reported a double-blinded study utilizing 59 client-owned horses randomly chosen and presented for a variety of equine clinical diseases. They evaluated the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of scan diagnosis and its correlation with conventional diagnostic methods. In addition, the diagnostic acupoint's reactivity grade was compared to lesion severity to evaluate any correlation between the 2 methods of disease diagnosis. They reported that the acupuncture points scan diagnosis demonstrated a sensitivity of 88.7% (true positive rate), a specificity of 86.9% (true negative rate), NPV value of 98.1% (percentage of non-lesions determined by the scan diagnosis also shown negative in the conventional examination) and positive predictive value of 50.6% (percentage of lesions determined by the scan diagnosis also shown from conventional examination). In addition, a statistically significant correlation (p-value <0.001) between acupuncture point reactivity and lesion severity was demonstrated.[21] These studies demonstrate that acupuncture point diagnosis be an adjunctive tool when diagnosing equine pain and/or structural diseases.

ACUPUNCTURE FOR GENERAL PAIN MANAGEMENT AND MECHANISM OF ACTION

A recent publication reported that acupuncture analgesia mediated through integration of the neuroendocrine-immune network (i.e. neurotransmitters, cytokines, hormones) in the body increased substances such as 5-hydroxytryptamine (5-HT) or serotonin, which increased the pain threshold and improved the absorption of pain inducing inflammatory substances.[22] Another study indicated that low-level laser acupuncture can improve the pain threshold of rabbits, goats, pigs, mice and dogs. It increased the concentration of 5-HT in cerebral spinal fluid which suppresses the evoked cortical potential thereby inhibiting pain.[23] A study using the rabbit knee osteoarthritis model evaluated EAP stimulation (2.0 Hz, continuous wave, 6 volts) of acupoints SP-10, ST-34, ST-35, *Nei-xi-yan*, ST-36 and GB-34 for 30 minutes once per day for 4 weeks. Results showed that EAP reduced the levels of inflammatory factors including IL-1α, TNF-β, and prostaglandin E_2 which alleviates the inflammatory reaction providing notable pain relief.[24]

The effect of different EAP frequencies (2 Hz, 40 Hz, 60 Hz, 100 Hz) on the pain threshold has also been studied using the goat as a model.[25] Two pairs of acupoints *Bai-hui* and *Qi-jia*, *Er-gen* and *San-yang-luo* were stimulated with EAP for 30 minutes. Their results showed that of the frequencies studied, EAP with 60 Hz had the best effect for pain relief. Follow-up studies confirmed that EAP also had an after-effect of pain relief.[25] This study indicated that after being stimulated via EAP with 60 Hz for 30 minutes, the pain threshold of goats increased and reached its peak at Hour 0 (i.e. at the end of EAP stimulation). The pain tolerance then decreased gradually to the baseline by Hour 5, however, by Hour 6 the pain threshold began to rebound and reached a second peak at Hour 8, and then gradually fell again reaching baseline at Hour 12. The mean pain threshold during the time from 0 to 12 hours after EAP was higher (p<0.05) than that at 0.5 hour before EAP, which showed that the EAP-induced analgesic after-effect lasted for at least 12 hours in goats.[26]

The efficacy of various frequencies of EAP for pain relief in 22 horses was systematically reviewed in a clinical trial.[27] Focused radiant light/heat was used as a noxious stimulus and was directed onto the equine pastern to elicit the classic flexion-withdrawal reflex. Hoof withdrawal reflex latency (HWRL) was defined as the time (in seconds) between lamp illumination and the withdrawal of the hoof. The results indicated that the HWRL is a valid measurement to assess pain perception and document pain relief from acupuncture. The study also demonstrated that EAP treatments for 30 minutes at high frequencies (120 Hz) induce a stronger analgesic effect than 30 minute EAP treatments at low frequencies (20 Hz) in local regions. The EAP treatments at lower frequencies, however, induced a longer analgesic effect.

A double 3x3 Latin Square design was applied in studying experimental lameness in 6 horses. Lameness was produced in each subject by tightening a setscrew against the sole of the hoof.[28] Lameness grading scores of 0, 1, 2 and 3 were used to evaluate the severity of lameness. Three types of stride length were measured: total stride length (TSL), front half stride length (FHSL) and back half stride length (BHSL). The difference between FHSL and BHSL was defined as DFB (difference front/back). The DFB increased significantly when the horse was lame suggesting that the DFB could be used as an objective parameter to measure lameness in horses. Plasma concentrations of β-endorphin, adrenocorticotropic hormone (ACTH) and cortisol were also measured in both experiments. The use of EAP was significant for: increased HWRL and reduced lameness score, while simultaneously increasing the plasma β-endorphin concentration. These results indicate that the release of β-endorphin may be the pathway for acupuncture pain relief in this experimental setting. None of the acupuncture treatments altered the ACTH

concentrations which indicates that ACTH is not involved in EAP analgesia.

A different result was reported, however, in a pilot study which indicated that acupuncture treatment had no effect on pain in horses.[29] Nine horses with palmar heel pain which varied from 1 to 3 on a lameness scale were randomly assigned to an acupuncture or control group. Twice weekly visits on non-successive days were made to each horse. Horses in the treatment group received 20 min of DNAP and EAP at each visit while horses in the control group received no treatment. The same acupuncture points were applied to each horse in the treatment group (n=5): *Bai-hui*, BL-11, BL-13, PC-1, HT-9, LU-1, LU-11 with dry needle; and SI-9 and LI-11 bilaterally with EAP at 2 to 5 Hz. The researchers found with observational grading that all 4 horses in the control group maintained the same grade of lameness through the duration of the study or improved on 1 or both limbs by no more than 1 grade of lameness. Of the 5 horses in the treatment group, 3 showed improvement of 1 lameness grade on 1 or both limbs, 1 horse did not change, and 1 horse's lameness worsened through the course of the study. There was no statistically significant difference in grade of lameness between treatment and control animals at both initial and final assessment. The researchers in this study concluded that acupuncture did not reliably modulate palmar heel pain in horses.[28] A 2006 systematic review indicated that there was no compelling evidence to recommend or reject acupuncture for any condition in domestic animals including horses and dogs even though some encouraging data did exist that warranted further investigation in independent rigorous trials.[30]

Different outcomes of acupuncture on lameness may be associated with the fact that lameness itself can be subjective to study. Objective gait analyses using inertial sensors were adopted in a blinded and crossover study in mildly lame horses. Objective gait analyses using quantitative sensor based gait analysis were performed before and after each treatment and at 1, 3 and 7 days after the last treatment.[31] Horses were assessed at the trot in a straight line on a hard surface (condition 1) and on the lunge on the left (condition 2) and right reins on a soft surface (condition 3). Acupuncture treatment was found to decrease hip hike difference under all assessment conditions including condition 1: control, 6.3 ±6.4 mm versus treatment, 0.2 ± 6.4 mm (p = 0.007); condition 2: control, 9.7 ± 7.8 mm versus treatment, 2.8 ± 7.8 mm (p = 0.032); condition 3: control, 7.3 ± 6.3 mm versus treatment, 2.7 ± 6.4 mm (p = 0.003)]. This study indicated that acupuncture treatment changed the horses' gaits (appreciable by objective analyses), with treated horses moving in a more symmetrical manner, which suggests a lesser degree of discomfort.

ELECTRO-ACUPUNCTURE ANALGESIA FOR SURGICAL PROCEDURES

Electro-acupuncture analgesia (EAA) was used for surgical procedures without anesthesia drugs for the first time in 1958.[32-33] In a different study, an EAA protocol was used for surgery on horses and donkeys.[34] The procedure was initiated by using a 20 Hz frequency for 10 minutes and then gradually increased to 55 Hz for another 10-20 minutes which was sustained for the entire surgical procedure. Surgeries on the head and neck, chest wall, thigh and abdomen, as well as castration were performed on 18 healthy experimental animals which included 10 stallions and 8 mares, 8-15 years old, weighing 350 to 450 kg. In addition, multiple surgical protocols (suturing skin lacerations, subcutaneous mass excision, hernia repair, castration) were successfully performed using the EAA protocol without drug induced general anesthesia in 7 clinical cases which included 2 foals, 1 gelding, 2 stallions and 2 donkeys. Each animal, whether clinical or experimental, had an independent acupoints plan, depending on the site of surgery with electro-acupuncture stimulation throughout the duration of the surgery.[34]

In another report, twenty-three surgeries in 23 cattle described the effectiveness of EAP induced surgical anesthesia/analgesia relative to regional needle placement.[35] The locations of regional EAP were divided into 4 groups: a dorsal acupoint group [*Tian-ping* (GV-5) and *Bai-hui*, (n= 7)]; a lumbar acupoint group [*Yao-pang* 1 (BL-21), *Yao-pang* 2 (BL-23), *Yao-pang* 3 (BL-24) and *Yao-pang* 4 (BL-25), (n=5)]; a combined dorsal-lumbar acupoint group (n=8); and a control group using the last intercostal space to the femoral area as sham acupuncture points (n=3). Surgeries performed on cattle in the dorsal acupoint group and assessed for degree of analgesia were 2 laparotomies, 3 umbilical hernia repairs and 2 castrations. Similarly, surgeries performed on cattle in the lumbar group were 5 omentopexy surgeries for correction of left-sided displacement of the abomasum, whereas surgeries performed on the dorsal-lumbar acupoint group consisted of 4 omentopexies for correction of left-sided displacement of the abomasum, 1 omentopexy for correction of right-sided displacement of the abomasum, 2 rumenotomies and 1 cesarean section. The acupoints were stimulated with currents of 2-6 V (30 Hz) in dorsal acupoint group, 0.5-2.0 V (30 Hz) in lumbar acupoint group and 0.3-2.5 V (30 Hz) in dorsal-lumbar acupoint group. The results of their analyses showed that the recumbency and induction time in the dorsal acupoint group approximated 10 seconds to 1 minute respectively and the induction time of analgesia was 1-6 minutes, in all animals except 1 who failed to respond to the EAP. The induction time of analgesia in the lumbar and dorsal-lumbar acupoint groups was slightly longer at approximately 10 minutes. The authors concluded that the use of their dorsal acupoint protocol in responsive animals might be useful in providing analgesia for surgeries requiring the patient to be in a recumbent position whereas the use of the lumbar and dorsal-lumbar acupoint protocol might be useful for standing surgeries in cattle.[35]

A clinical trial (cross-over design) was conducted to compare the effects of EAP and butorphanol on rectal analgesia in mares (n=8) using controlled rectal distention as a noxious stimulus.[36] Animals were also monitored for

changes in hemodynamic and respiratory variables. Each horse received saline (0.9% NaCl) solution (0.01 mL/kg, IV; control treatment), butorphanol tartrate (0.1 mg/kg, IV), or 2 hours of EAP at acupoints *Bai-hui*, bilateral BL-21, 25, 27 and ST-36 (right side only). The order of treatments in each mare was randomized. At least 7 days elapsed between treatments. A balloon was inserted in the rectum of each mare, and controlled distention of the balloon (pressures of ≤ 220 mm Hg) was used to measure nociceptive rectal pain threshold. Both butorphanol and EAP provided statistically equal analgesia to induced rectal stimuli (mean +/- SD, 214 +/- 24 vs 174 +/- 35 mm Hg of balloon pressure, respectively). The conclusions and clinical relevance were that EAP and butorphanol (0.1 mg/kg, IV) may provide useful rectal analgesia in horses and EAP produces less effect on hemodynamic and respiratory variables when compared to butorphanol.

ACUPUNCTURE FOR TREATMENT OF OTHER CONDITIONS IN HORSES

Back Pain

A prospective study was conducted to evaluate the use of EAP in the treatment of horses with signs of chronic thoracolumbar pain.[37] Fifteen horses were randomly allocated to 1 of 3 treatment groups. Horses in Group 1 received EAP stimulation (once every 3 days for 5 treatments), those in Group 2 received phenylbutazone (2.2 mg/kg [1 mg/lb], PO (per os), q (every) 12 hours, for 15 days), and those in Group 3 received 0.9% NaCl saline solution (20 mL, PO, q 12 hours for 15 days). Thoracolumbar pain scores (TPS) were evaluated before (baseline) and after each treatment. The TPS in horses receiving phenylbutazone and saline solution did not change significantly during the study (p=0.999 and p=0.535 respectively). After the third treatment, TPS in horses receiving EAP stimulation were significantly lower than baseline (p<0.01) and decreased from 6.0 ± 0.6 to 2.1 ± 0.6. The statistically significant lower scores were maintained through follow-up 14 days after the 5th treatment. These results provided evidence that three sessions of EAP treatment can successfully relieve signs of thoracolumbar pain in horses and the analgesic effect induced by EAP can last for at least 20 days. Alternatively, the oral administration of phenylbutazone was not found to effectively relieve signs of thoracolumbar pain.

Another clinical trial found that EAP relieved chronic back pain in performance horses.[38] This study was a randomized, double blind, controlled trial to evaluate EAP as a treatment for back pain in sport horses. Objective measurements of pain threshold levels were obtained with a pressure algometer. Twenty-three horses with chronic back pain were divided into control (n=7) and treatment (n=16) groups. Trigger (painful) points were identified on each horse and baseline pain threshold measurements were taken. The control group received sham EAP treatments with no needle penetration or electrical stimulation. Routine EAP was performed in the treatment group using filiform acupuncture needles inserted into GV-20, GV-6 and bilaterally at BL-26, BL-54, BL-21 and BL-17. Needles were connected to 5 pairs of electrical wires and an electrical impulse (4.5 volts) was delivered at a frequency of 20 Hz for 15 minutes and 80-120 Hz for 15 minutes. Both sham and control EAP treatments were given over the course of 5 sessions, each spaced 3 days apart and all horses were rested during the study period. After 5 treatments, pressure induced pain was statistically significantly reduced at the trigger points in the treatment group when compared to the control group using an unpaired t-test (p=0.034). The conclusion was that EAP and rest is an effective treatment for sport horses with chronic back pain and is better than sham EAP and rest over a 15-day period. Similar findings have also been reported by other researchers.[39-40]

Laminitis and Navicular Disease

A study was conducted to compare lameness levels before and after acupuncture treatments in horses with chronic laminitis.[41] Twelve adult horses with chronic laminitis received 2 acupuncture treatments 1 week apart. The points were treated using dry needle, hemo-acupuncture and aqua-acupuncture. Lameness level was objectively evaluated using a commercial inertial sensor-based lameness evaluation system[a], as well as routine examinations following the American Association of Equine Practitioners scoring before the first and 1 week after the second acupuncture treatment. Data were analyzed using Wilcoxon signed-rank test and p-values < 0.05 were considered statistically significant. Both the inertial sensor-based lameness evaluation system (p = 0.0269) and routine lameness examination (p = 0.0039) showed a significant reduction in lameness severity. This clinical trial supports using acupuncture, along with other treatment options, in treating chronic equine laminitis.[41] Researchers in a different clinical trial, however, obtained conflicting results which indicated that EAP used for treatment of chronic laminitis (n = 5) or navicular disease (n = 5) did not have a significant difference when comparing clinical scores between experimental and control groups.[42] The authors of this study pointed out that the small number of animals per group may have obscured a positive treatment effect with acupuncture. In addition, the lower frequency used in this study (5 Hz for 20 minutes, local acupoints) may be a factor as it countered the relatively recent study in which a high frequency (120 Hz for 30 minutes, local acupoints) induced a stronger analgesic effect than low frequencies (20 Hz for 30 minutes) in the local foot region.[42] Other reports support the use of acupuncture for the treatment of laminitis and navicular syndrome.[43-44]

Cervical Stiffness

Eighteen (18) horses diagnosed with cervical stiffness were randomly divided into a Test Group and a Control Group.[45] Horses in the Test Group received 3

acupuncture treatments (DNAP and EAP), 7-10 days apart, using bilateral 1-2 inch needles dependent on anatomic site: DNAP at *Shen-shu*, BL-62, SI-3, LIV-3, LI-4 and EAP (20 Hz, 10 minutes) at BL-10 + *Jing-jia-ji* (C3-4), *Jing-jia-ji* (C4-5) + *Jing-jia-ji* (C6-7). Horses in the Control Group received treatment on the same schedule but using 0.5mm press needles at non-acupuncture points. From each horse, two measurements of cervical lateral bend were taken prior to the first treatment and again 1 day after the last treatment. One measurement was the amount of bend before refusal (maximal bend, R1) and the other was amount of bend before compensation (Pre-compensation, R2). The comparison of the changes between the Test Group (9.83 ± 8.87) and the Control Group (-6.83 ± 15.26), based on the Wilcoxon Rank Sum test, revealed that the mean R1 change in the Test Group was significantly larger than that in the Control Group (p = 0.019). The same analysis on R2 bend measurement reached the same conclusion (12.22 ± 8.82 test vs. -5.17 ± 13.07 control; p = 0.008). This study demonstrated that acupuncture can improve lateral bend in horses and can be an effective treatment for cervical stiffness.

In a retrospective study, case files for nineteen animals (13 dogs and 6 horses) with wobbler syndrome ranging in age from 4 months old to 14 years old were reviewed.[46] Dog breeds included: 4 Doberman Pinschers, 2 German Shepherds, 2 Great Danes, 1 Greyhound, 1 Rottweiler, 1 Weimaraner, 1 Dalmatian and 1 Australian cattle dog. Horse breeds included 2 Thoroughbreds, 1 Standardbred, 1 Warmblood, 1 Andalusian, and 1 Saddlebred. Six dogs and 1 horse presented with at least one conventional medical diagnostic test, including radiographs, myelogram and magnetic resonance imaging (MRI). Twelve animals (7 dogs and 5 horses) presented with clinical signs typical of wobbler's syndrome, including ataxia and/or hind end weakness. Assessment of clinical signs of the animals varied based on degree of neurological dysfunction or pain measured on a 5 point grade scale. All 19 cases were treated with both acupuncture and Chinese herbal medication. Acupuncture treatment included dry needle at *Bai-hui* and BL-23; electro-acupuncture (20 Hz for 5 to 10 minutes + 80-120 Hz for 15 to 20 minutes) at up to seven pairs of acupoints: GB-20 + GB-21 (crossed right to left and left to right), local *Jing-jia-ji* points for affected cervical vertebrae, ST-36 + GB-34, BL-54 + KID-1, GV-14 + GV-20 in dogs, or BL-10 + BL-11 in horses; Aqua-AP (vitamin B12) at *Jing-jia-ji*, BL-62, SI-3, KID-6. One session of acupuncture treatment per 1 to 4 weeks was given for a total of up to 6 sessions. The Chinese herbal medicine, Cervical Formula[b] (*Jing Tong Fang*) was used orally for all patients. Double P II [b] (modified *Da Huo Luo Dan*) was given orally to patients that had a neurological grade of 2 or higher. Body Sore [b] (*Shen Tong Fang*) was given orally to patients with neck pain and used as needed. After 5 to 8 sessions of acupuncture treatments and 2 to 3 months of herbal medication, 10 (52.6%) out of the 19 cases had complete clinical recovery, and 8 (42.1%) had a substantial improvement (improved at least one neurological grade). Only 1 of 19 cases (5.3%) had no improvement. All 18 cases that responded to TCVM were followed for at least 6 months, and demonstrated stable clinical signs and good life quality (including daily walk, normal urination/defecation, good appetite).

Reproductive Disorders and Mastitis

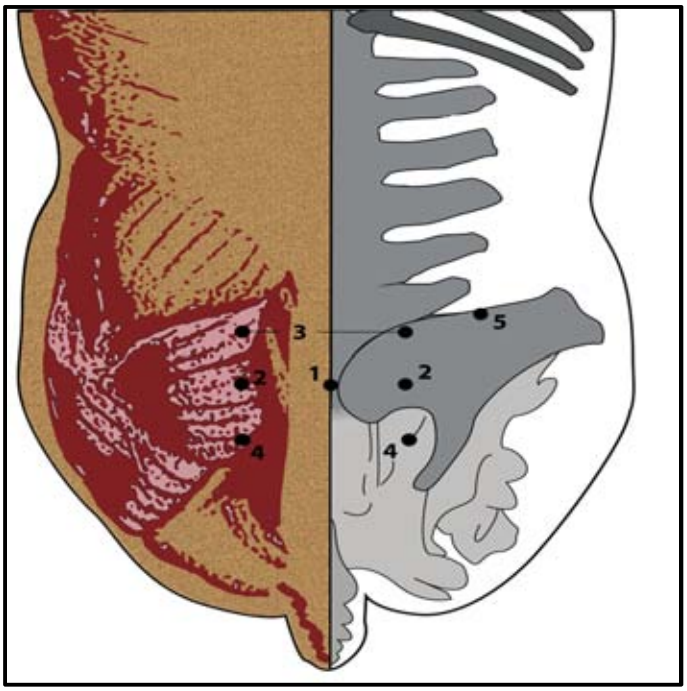
The treatment of reproductive disorders and the promotion of fertility represent cornerstones of the equine and bovine industries. Acupuncture has anecdotally produced excellent results for treating mares with uterine fluid and/or urine pooling, especially older, pluriparous mares.[47] In a bovine study, 57 dairy cows that were diagnosed with infertility due to inactive ovaries were randomly assigned into four groups: electro-acupuncture (n=15), Aqua-AP (n=15), hormones (n=15) and control (n=12). Four acupoints used in both EAP and Aqua-AP groups were *Bai-hui* and GV-1, and bilateral *Yan-chi*. In the EAP group an alternating frequency setting between 80-100 Hz was used for 30 minutes once a day for three consecutive days.[48] For Aqua-AP, 15 ml of 5% dextrose was injected into each of these 4 points, once daily for 3 consecutive days. For the hormone group, FSH (100-200 units per injection) was given intramuscularly twice, 48 hours apart. For the Control Group, no treatment was given. After treatment in the EAP group, 13 out of 15 dairy cows (86.7%) had a normal estrus, were inseminated, and 12 (80%) were diagnosed pregnant. In the Aqua-AP group, 9 out of 15 cows (60%) had a normal estrus, were inseminated, and 7 (46.7%) were diagnosed pregnant. In the hormone group, 12 out of 15 (80%) had a normal estrus, were inseminated, and 11 (73.3%) were diagnosed pregnant. In the control group, 4 out of 12 cows (33.3%) had a normal estrus, were inseminated, and 2 (16.7%) conceived. The estrus and pregnant rates were not significantly different between the EAP and hormone groups, and between the Aqua-AP and control groups, but rates in both EAP and hormone groups were significantly higher than the control and Aqua-AP groups. In both EAP and hormone groups, the milk progesterone level increased significantly after the treatment. This study indicated that EAP was an effective therapy for infertility due to inactive ovaries.

A clinical study demonstrated that Aqua-AP of herbals at GV-1 can prevent retained placenta in cows.[49] One hundred and twenty four pregnant dairy cows were selected to be in an untreated control group and observed after calving to determine the retained placenta rate for the farm. Fifty-two pregnant dairy cows from the same farm were selected for the study and randomly assigned to two groups: 30 cows in the herbal *Dang Hong Fu* group and 22 cows in a saline control group.[49] Immediately after calving 40 ml of *Dang Hong Fu* (40 grams of dried herbs) were injected into GV-1 in the herbal group and 40 ml of physiological saline were injected at the same site in the saline control group. Both groups were observed for retained placentas and the time until placental expulsion was recorded in the others. The retained placenta rate for

untreated cows that received no treatment was 35.5% (44/124). The incidence of retained placenta in the *Dang Hong Fu* group was 16.7% and in the saline control group 31%. The time for expulsion of placental membranes was a mean of 9 hours (range 3.5-24 hours) in the *Dang Hong Fu* group and a mean of 14.7 hours (range 3.0-24 hours) in the saline control group. When compared to the untreated control group, *Dang Hong Fu* aqua-AP at GV-1 significantly reduced the incidence of retained placentas (p=0.047; <0.05), but saline aqua-AP did not (p=0.740; >0.05). Herbal aqua-AP may offer an easy treatment method to reduce the incidence of retained placenta in the cow with no observed adverse side effects.

Promising human studies have prompted calls for mergers between Chinese and conventional approaches.[50] The authors of a systematic review involving a total of 12 clinical trials and 2,177 patients, concluded that the effect of acupuncture on human male infertility was equally effective as prescribing herbals within traditional Chinese medicine (TCM), and its effectiveness is enhanced when applied in combination with either TCM or conventional medicine.[51] In another study, 114 human patients of *in vitro* fertilization embryo transfer (IVF-ET) treated with a standard long-term program at luteal phase were randomized into an acupuncture group or a control group, 57 cases in each.[52] In the acupuncture group, at the beginning of ovulatory induction, moxibustion was applied to CV-8, and acupuncture at CV-3, CV-4, CV-6, SP-6, SP-9, SP-10, ST-36, PC-6, LI-4 and LIV-3 periodically from oocyte aspiration until the time of embryo transfer (i.e., the time the embryo was transferred to the patients) for one session of treatment. There was a total of 3 treatment sessions in the study. Results indicated that acupuncture and moxibustion affect estrogen level on hCG day, improve high-quality embryo rate, endometrial blood flow state and morphology so that the endometrial receptivity is increased.[52]

Equine studies, however, have had conflicting results.[53-55] In addition to the fact that human oocytes are capable of *in vitro* fertilization whereas equine oocytes are not and require sperm injection, one reason for the variable results is likely related to the lack of the important classical equine acupoint, *Yan-chi*, that is a specific acupoint for equine infertility (Figure 1 and Table 1).[56] Secondly, the practitioner must rely on the classic Chinese differentiations of specific patterns for point recommendations. For example, ovulatory dysfunction, regardless of cause, is viewed as one of a number of possible deficiency patterns with treatment aimed at strengthening the deficient area of the body. Improved clinical results may include using acupoints SP-6, KID-3, KID-7 and KID-10. And third, CV-4 and CV-6 in particular are among a group of points found to possess endocrine effects pertinent to reproduction, specifically ovulation in humans. The use of these acupoints in the mare, while clinically efficacious, are difficult as well as dangerous to access, thus it is almost impossible to treat these acupoints. Other reproduction related acupoints may be used such as *Yan-chi*, *Shen-shu*, *Shen-peng* and *Shen-jiao* if the diagnoses indicate (Figure 1 and Table 1).



1=*Bai-hui*, 2=*Shen-shu*, 3= *Shen-peng*, 4= *Shen-jiao*, 5= *Yan-chi*

Figure 1: Acupuncture points used commonly for infertility in horses.[56]

Table 1: The commonly used classical acupoints in horses with anatomical location and indication for use.[56]

Acupoint	Anatomy*	Indication
Bai-hui	On dorsal mid-line at the lumbosacral space	Lumbar pain, hindquarter pain or weakness, general calming, *Yang* Deficiency, infertility
Shen-shu	2 *cun* lateral to *Bai-hui*	Lumbar pain, infertility, general pain management, hindquarter weakness
Shen-peng	2 *cun* cranial to *Shen-shu*	Same as *Shen-shu*
Shen-jiao	2 *cun* caudal to *Shen-shu*	Same as *Shen-shu*
Yan-chi	Midpoint between top of tuber coxa and *Shen-peng*	Female or male infertility, poor athletic performance, hindquarter pain/arthritis

**cun* is an acupuncture point measurement unit. The length of the first tail vertebra or the width of the last rib is equal to 1 *cun.*

Stress Response

Acupuncture has been shown to have the beneficial effect of reducing stress responses in horses.[57] A study was conducted to compare the effects of injecting the standard dose of acepromazine (0.1 mg/kg, IM) to Aqua-AP (1/10 of the standard acepromazine dose at the acupoint GV-1) on the stress responses of healthy horses undergoing road transport for 2.5 hours. Four different treatments were applied immediately before loading, with 8 animals/treatment: injection of saline or acepromazine (0.1 mg/kg, IM) at the base of the neck and injection of saline or 1/10 acepromazine (0.01 mg/kg) at the GV-1 acupoint. The road transport increased heart rate (HR), respiratory rate, body temperature, and serum cortisol of the untreated horses (injected with saline at the base of the neck). Aqua-AP (0.01 mg/kg acepromazine) at GV-1 reduced the average HR and transport-induced increase in HR at unloading, without changing the other variables. On the other hand, acepromazine at conventional dose (0.1 mg/kg) produced significant sedation and reduced the transport-induced increase in respiratory rate but without preventing the stress-induced increase of cortisol.[57] Similarly, sedation was induced in horses receiving a 20-minute session of dry needle acupuncture at GV-1, HT-7, GV-20 and BL-52 assessed by the failure to fully respond to the sudden appearance of a multi-colored umbrella as a stressor.[58]

Emergency Resuscitation

Acupoint GV-26, which in the horse is located just below the nostrils at the midpoint of the philtrum nasale, can be used in an emergency situation to resuscitate animals including the horse (Figure 2).[59] A study of 69 cats and dogs reported that acupuncture at the acupoint GV-26 restored respiration to normal or near normal rates within 10 to 30 seconds of needle insertion in 100% of animals if there was no concurrent cardiac arrest. When cardiac arrest occurred and vital signs were absent the revival rate was 43%.[60] In a clinical report with patients following narcotic induced narcosis, 243 cases in 17 different species of domestic, exotic animals and birds; acupuncture resuscitation approached the 100% efficacy reported in clinically healthy dogs.[61] In animals affected with different diseases, however, the success of intervention was smaller (77.47%). In zoo animals suffering from narcosis, the resuscitation effectiveness achieved was 92.6%. The resuscitation effect was based not only on strictly determined acupoints but also on diffusive irritation of the respective point and its surroundings by acupressure. These studies indicate what has also been widely discussed and anecdotally demonstrated by practitioners in the field for many years.

Metabolic Capacity

Eighteen Thoroughbred racehorses were randomly divided into three groups (n = 6/group): negative control, sham aquapuncture (positive control) or treatment aquapuncture groups. Horses in the treatment group received 5 mL distilled water injected into acupoints including *Bai-hui*, ST-30, ST-36, GB-27, SP-13 and BL-22 along with hemo-acupuncture (bleeding) at TH-1 and BL-67. The horses completed six Aqua-AP sessions during a 3-week study period (twice weekly). All horses had the same trainer/jockey and completed at least 8 months of training and racing. The horses did not race during a 2-week period before and after the experiment. Cardiovascular values were not different between times or groups. The metabolic capacity values V_{La4} and V_{200} were statistically greater after treatment only for the acupuncture group compared with pretreatment. Creatine kinase concentrations were statistically greater after exercise for all groups, and aspartate aminotransferase

concentrations were not different between times or groups. This study indicated that acupuncture increased the anaerobic metabolism of Thoroughbred horses without interference in cardiovascular performance or release of muscle enzymes in medium load exercises.[62]

Laryngeal Hemiplegia

Laryngeal hemiplegia (LH) is an important disease related to poor performance and upper respiratory noise in horses.[63] While surgical procedures may be effective in young horses with grade III or IV disease, surgical procedures may be inconvenient for the treatment of LH in horses if the problems occur during the sale seasons or may be rejected as a treatment by some horse owners. Owners may therefore try to find alternative methods for the treatment of recurrent laryngeal neuropathy. Thoroughbred horses (n=18) referred to the acupuncture service at the Veterinary Medical Center at the University of Florida for the treatment of LH were involved in this study. All horses underwent endoscopy with left-sided flaccid laryngeal tissue that adducted during breathing noted during the exam. The hemiplegia endoscopic grades ranged from IIa to IIIb. Electroacupuncture was performed once per week for a total of 3 to 7 times depending on the severity of hemiplegia. The acupoints used were LI-15, LI-17, LI-18, GB-21, CV-23, ST-9, SI-17, *Hou-bi* and *Hou-shu*. The EAP treatment used 20 Hz for 10 minutes, then at 80 to 120 Hz for 10 minutes. All horses had endoscopic examinations by independent (blinded) equine practitioners after 1 or 2 days following the last EAP treatment. The endoscopic grades of hemiplegia had improved in all horses, to between normal and grade IIb (minor flutter or delay in laryngeal movement). The respiratory noise during training also appeared to be improved after the treatment.[64]

Figure 2: The GV-26 acupuncture point is commonly used for emergency resuscitation in horses. The acupoint is located on the midline, on the upper lip, between the ventral limits of the nostrils.[59]

Stem Cell

The effects of EAP on the mobilization of stem cells in horses, mice, rats and humans has recently been studied.[65] In all four species, equivalent acupoints LI-4, LI-11, GV-14 and *Bai-hui* (or GV-20 in humans) were used with EAP stimulation of 30 Hz for 45 minutes. Stimulation using EAP in humans, horses, mice and rats resulted in mobilization of mesenchymal stem cell (MSC)-like cells into the systemic circulation. When examined by an *in vivo* angiogenesis assay the MSC origin of EAP-mobilized cells was supported because the cells did not directly form blood vessels or lumenize, thereby supporting a nonendothelial origin. Mobilization of MSC-like cells was preceded by a time-dependent increase in plasma norepinephrine levels and was blocked by pretreatment with propranolol. Analysis by fMRI in EAP-stimulated rats revealed increased functional connectivity between the anterior hypothalamus and the amygdala. Pharmacological disinhibition of these regions enhanced sympathetic activation and similarly resulted in release of MSC-like cells into the circulation. Following partial rupture of the Achilles tendon, EAP produced long-lasting and powerful analgesia and generation of increased type 1 collagen content, indicative of tendon injury remodeling; however, this effect was blocked in propranolol-treated rats. Thus, EAP activates the sympathetic nervous system to mobilize MSC-like cells into circulation which can be used to enhance tissue repair and provide analgesic relief.

CONCLUSION

Acupuncture stimulation, especially electro-acupuncture, can release neurotransmitters such as 5-HT, serotonin and endogenous opioids including β-endorphin, which appear to be the main pathways in which acupuncture relieves pain. Although the strength of the clinical trials cited above vary, acupuncture has been shown to be a viable integrative treatment for back pain, foot pain, cervical stiffness, laryngeal hemiplegia and infertility in horses. Acupoint sensitivity on palpation may be useful for the assessment of lameness along with conventional diagnostics in horses. Future well-designed studies are needed in order to strengthen the recommendation for acupuncture in the diagnosis and treatment of clinical conditions in horses.

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Declaration of Ethics: Authors declare that they have adhered to the Principles of Veterinary Medical Ethics of

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FOOTNOTES

a. Lameness Locator™, Equinosis LLC, Columbia, MO USA

b. Jing Tang Herbal, Ocala, FL USA

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Traditional Chinese Veterinary Medicine for Avian, Laboratory and Exotic Species

The Successful Use of Veterinary Chiropractic, Acupuncture and Chinese Herbal Medicine to Treat a Guinea Keet with *Tan-huan* Syndrome

Brenna N. Burkett DVM

ABSTRACT
An approximately two-week old Guinea keet presented for evaluation and treatment of acute paresis and paralysis of 24-hour duration. Based on the lack of improvement with nursing care, severity of clinical signs and lack of conventional options, the decision was made to pursue treatment using traditional Chinese veterinary medicine (TCVM) and veterinary chiropractic medicine (VCM). Although limited, the TCVM examination revealed a cold, lethargic, weak patient with a pale tongue and history of acute paresis and paralysis secondary to a traumatic event. The TCVM pattern identified was *Tan-huan* syndrome with *Qi*/Blood Stagnation and *Qi/Yang* Deficiency. After initiation of treatment was begun, the patient was monitored daily to evaluate any changes in clinical signs of *Bian Zheng* (Pattern Diagnosis). Marked improvement and resolution of clinical signs at 67 hours and continued improvement 44 days later indicated a positive response to treatment. This clinical case highlights the successful use of TCVM and VCM to successfully treat *Tan-huan* syndrome with local *Qi*/Blood Stagnation and *Qi/Yang* Deficiency in a juvenile Guinea keet.

Keywords: traditional Chinese veterinary medicine, Chinese herbal medicine, acupuncture, veterinary chiropractic medicine, avian, paresis, paralysis

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ABBREVIATIONS

BCS	Body condition score
CHM	Chinese herbal medicine
DNAP	Dry needle acupuncture
TCVM	Traditional Chinese veterinary medicine
VCM	Veterinary chiropractic medicine

An approximately two-week-old Guinea keet was presented with a 24-hour history of paresis and paralysis after being found with a foot entrapped in a section of the brooder. Nursing care was initiated but after lack of improvement with conventional treatment, the patient was presented for traditional Chinese veterinary medicine (TCVM) evaluation.

On initial physical examination, the bird was slightly under-conditioned with a body condition score equal to 3/5. A limited physical exam was performed and revealed a cold, lethargic, weak, dehydrated patient. Additionally, the eyes were sunken with pale conjunctiva bilaterally along with a pale tongue and dry vent. Although the bird could move (paddle both legs through a normal range of motion), it could not right itself or stand and deep pain responses were absent in the right limb.

Based on severity of clinical signs, lack of option for referral to a specialist, financial constraints and grave prognosis without intervention; the decision was made to pursue integrative veterinary care for 24 hours. If no improvement was noted during that timeframe, the bird would be euthanized. The decision was made to treat with multiple integrative modalities: acupuncture, veterinary chiropractic medicine (VCM) and traditional Chinese veterinary medicine. Based on history and clinical presentation, the patient was diagnosed with *Tan-huan* syndrome characterized by acute paresis/paralysis due to trauma resulting in *Qi* and Blood Stagnation. Additionally, a Kidney *Qi/Yang* deficiency was diagnosed based on the debilitation of the patient and overall cold body and extremities. Treatment principles included resolving pain, Blood Stagnation/Stasis along with tonifying *Qi* and invigorating/moving Blood.

The treatment plan included Chinese herbal medicine, VCM, dry needle acupuncture at *Liu-feng* acupoints using 1.5x20 mm sterile needles[a] and

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Author Professional Certifications: CAVCA, CVTP, CVFT, CVA, CVCH

supportive care (Table 1).[1-3] The acupoints and Chinese herbal formula were chosen to resolve *Qi*/Blood Stagnation. Based on the size of the patient and the inability to localize individual subluxations, VCM treatment consisted of cervical traction. The patient was anorexic at presentation, but this was contributed to its inability to right itself.

Treatment with the Chinese herbal medicine, Double P II[b] was initiated to break down Stasis in the spine, move *Qi* and relieve pain.[4] This Chinese herbal formula is usually administered at approximately 0.1 g/kg for birds. Due to the inability to weigh the small bird in a field situation, a very tiny amount of a 0.5g capsule was sprinkled into the bird's fluids twice daily and administered via syringe (Table 2). Additionally, the bird was placed under a heat lamp and a harness with sling was made to help support the patient in an upright position. Close monitoring every two hours throughout the night was instituted and oral fluids with electrolyte supplementation[c] were administered orally via a tuberculin syringe. A commercially available wild game bird feed[d] was also made available every two hours.

Table 1: Acupoint used to treat a Guinea keet presenting with paralysis and TCVM Pattern diagnoses of *Tan-huan* syndrome and Kidney *Qi/Yang* Deficiency; the location, technique, indications and actions of the acupuncture point is listed.[1-3]

Acupoint	Location	Technique	Indications and Actions
Ba-feng (Liu-feng)*	Between the digits in skin folds, 3 points on each foot; Insert needle through webbing and dorsal to the MCP/MTP joints	DNAP	TL spinal cord lesions between C7-S1, *Qi*/Blood Stagnation, paresis, paralysis

TL=thoracolumbar, MCP=metacarpal phalangeal, MTP=metatarsal phalangeal, DNAP=dry needle acupuncture
**Ba-feng* refers to 4 needles per foot (humans) and is the term used for this acupoint in poultry literature[3] versus *Liu-feng* which refers to 3 needles per foot as in other species.[1]

Table 2: Ingredients and actions of the Chinese herbal medicine formula, Double P II[b]. The patient in this case received an approximate amount (0.1g/kg) as the author used a small fraction of a 0.5g capsule mixed in water and administered orally via a tuberculin syringe twice daily.[4]

Chinese *Pin Yin*	English Name	Actions
Ba Ji Tian	Morinda	Warms *Yang* and tonifies Kidney
Du Zhong	Eucommia	Strengthens back, tonifies Kidney *Yang*
Bu Gu Zhi	Psoralea	Tonifies Kidney *Yang* and strengthens bones
Chi Shao	Chinese Peony	Cools Blood, resolves Stagnation
Chuan Niu Xi	Cyathula	Tonifies Kidney *Yang*, strengthens rear limbs
Chuan Xiong	Sichuan Lovage	Activates Blood, resolves Stagnation
Dang Gui	Dong Quai	Nourishes Blood, activates Blood, relieves pain
Gu Sui Bu	Drynaria	Strengthens bones and tonifies Kidney *Yang*
Huang Qi	Astragalus	Tonifies *Qi*
Mo Yao	Myrrh	Resolves Stagnation and relieves pain
Quan Xie	Buthus	Resolves Stagnation
Ru Xiang	Frankincense	Resolves Stagnation and relieves pain
Tian San Qi	Tienchi Ginseng	Moves Blood, stops hemorrhage
Xu Duan	Sichuan Teasel	Strengthens bones, tonifies Kidney *Yang*
Gan Cao	Chinese Licorice	Harmonizes
Wu Yao	Lindera	Moves *Qi* and relieves pain
Fu Zi (*Shu*)	Sichuan Aconite	Warms *Yang* and Channels
Hong Hua	Safflower	Moves Blood, resolves Stagnation and Stasis
Ma Qian Zi (*Zhi*)	Strychnos	Activates Channels, relieves pain
Xue Jie	Draxonis	Resolves Stagnation

CASE PROGRESS

The focus of the initial visit was a consult and to perform a TCVM evaluation with initiation of immediate aggressive treatment. Eighteen hours following presentation, the Guinea keet was brighter with an alert mentation and had not only expressed an interest in food and water but was eating and drinking when nutrition/liquids were offered. The patient was still unable to right itself or stand unassisted but could now hold its head upright. The bird could also now sit with legs underneath it while still in harness as opposed to lateral recumbency and was able to curl and uncurl the toes of the left limb. The treatment plan remained the same and included continuing cervical traction and Chinese herbal medicine twice daily along with dry needle acupuncture using *Liu-feng/Ba-feng* once daily for 15 minutes (Figure 1). The bird was kept in its harness-sling apparatus under a light with food and water offered every two hours. The patient continued to improve throughout the day and eventually began making efforts to reach the food and water on its own (Figure 2).

Forty-two hours following presentation, the Guinea keet was bright and alert, had defecated and was exhibiting preening behavior. When removed from the harness, the patient could stand and was actively alternating picking up and placing the right and then the left foot in an attempt to help maintain its balance. As the bird was able to remain out of the harness apparatus, free access to food and water was provided with close monitoring of the amount consumed. Cervical traction was again performed that morning. With the resolution of the paralysis, the Chinese herbal medicine and acupuncture were discontinued at this time. The bird continued to improve over the following 24 hours.

Sixty-seven hours after initial presentation, the Guinea keet was standing and running around the make-shift brooder along with flying up and over the edge. Cervical traction was performed one last time and the patient was returned to the brooder with the remainder of the keets. At 3 months post initial presentation, clinical exam documented the Guinea keet was continuing to do well. The keet had transitioned from life in the brooder to life in a small coop with the other keets. Other than being approximately 2/3 the size of the remaining Guinea keets there were no other obvious differences between the affected keet and the other birds.

DISCUSSION

Similar to other domestic species, paresis and paralysis in avian patients can be due to a variety of potential causes including congenital, toxic, infectious, nutritional, metabolic or traumatic. Management and treatment of these cases can be challenging.[5] Regardless of cause, conventional treatment of spinal disorders resulting in neurologic deficits in avian species include treating the underlying cause, protecting the skin for recumbent birds, physiotherapy and supportive care.[3]

From a TCVM perspective, ataxia, paresis or paralysis known as *Tan-huan* syndrome is associated with Kidney *Qi* Deficiency and is due to *Qi*/Blood Stagnation in the spinal cord.[2,4] The spinal cord *Qi*/Blood Stagnation causes local *Qi*/Blood Deficiency that reduces

Figure 1: Mac hand needles placed in both feet at *Ba-feng* (4 acupoints per foot) at each acupuncture session in a guinea keet affected with *Tan-huan* syndrome.

Figure 2: After initial treatment, the patient continued to improve over the next few days and eventually, while in the harness, began making efforts to reach the food and water on its own.

normal spinal cord functions and results in neurological deficits caudal to the lesion. Once neurological deficits are evident, the primary TCVM Pattern is Spinal Cord *Qi*/Blood Stagnation with Kidney *Qi*, *Yang* and/or *Yin* Deficiencies.[2] Paralysis associated with evidence of Cold on the TCVM examination, as in the present case, is typical of the TCVM Pattern of Spinal Cord *Qi*/Blood Stagnation with Kidney *Yang* Deficiency (*Qi* Deficiency + Cold clinical signs = *Yang* Deficiency).[2] The treatment principle for all traumatic cases includes resolving *Qi*/Blood Stagnation to return proper *Qi* and Blood flow to the spinal cord which decreases pain and resolves paresis/paralysis.[1,2]

SUMMARY

Paresis and paralysis are significant clinical signs that arise from a variety of conditions but regardless of cause usually result in a poor quality of life and often euthanasia. Despite the unusual species and juvenile age of the patient, which made body weight determination and exact dosing of Double P II[b] a challenge, this case demonstrates that combining integrative veterinary therapies could be considered as a treatment option for avian species with paresis and paralysis of unknown origin.

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FOOTNOTES

a. Jing Mei Mac Hand Needles, Dr. Xie's Jing Tang Herbals Inc, Ocala, FL, USA

b. Double P II, Dr. Xie's Jing Tang Herbals Inc, Ocala, FL, USA

c. Sav-A-Chick 01-7451-0202 Electrolyte & Vitamin Chicken Supplement, Chilton, WI, USA

d. Purina Game Bird and Turkey Starter, Arden Hills, MN, USA

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Pearls from TCVM Practice

Treatment of Equine *Shen* Disturbance with Traditional Chinese Veterinary Medicine

Emily R. Mangan DVM

ABSTRACT

Horses with behavioral abnormalities may injure themselves or their handlers, display aggression towards humans and other horses and disrupt the human-horse relationship. These behaviors are precipitated by stressful events, such as frightening experiences, changes in herd dynamics or training, traveling and showing experienced frequently by equine athletes. Diagnosis and treatment of equine behavior is challenging with conventional medicine. Traditional Chinese veterinary medicine (TCVM) offers a unique treatment perspective for unwanted equine behavior. In TCVM, equine behavioral abnormalities are commonly due to *Shen* Disturbance, which may be caused by six underlying TCVM pattern diagnoses: Liver *Qi* Stagnation, Phlegm Fire Flaring Upward, Phlegm Misting the Mind, Heart *Yin* Deficiency with False Heat, Heart *Yin*/ Blood Deficiency and Heart *Qi* Deficiency. Each pattern has distinguishing features on the TCVM exam which aides in accurate pattern diagnosis which is critical for effective treatment selection of acupuncture points and Chinese herbal medicine. The use of TCVM treatment utilizing acupuncture and Chinese herbal medicine can be an effective approach either as a sole treatment for mild behavior cases or as part of a comprehensive program to resolve unwanted equine behavior and safeguard the wellbeing of horses and their handlers.

Keywords: equine, behavior, *Shen* Disturbance, acupuncture, Chinese herbal medicine

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ABBREVIATIONS

TCVM Traditional Chinese veterinary Medicine

Abnormal equine behavior presents unique diagnostic and treatment challenges for the veterinary practitioner.[1] This type of behavior is frequently refractive to treatment and even if initially responsive, the behaviors may recur throughout life, even after long periods of quiescence.[2-4] Unwanted equine behavior is the reported cause for 28% of the total 200,000 horses that are relinquished to rescue organizations annually in the United States.[1] Even though problem behaviors may be categorized as reactionary or learned, most have a root cause of underlying stress/anxiety which may have originated from changes in herd dynamics, frightening experiences or training, traveling and showing experienced frequently by equine athletes.[2-5] Anxiety-related behavior may range from stereotypies (i.e. cribbing, weaving) which create a management nuisance, to severe behavioral abnormalities which can endanger the horse and handler like bucking, bolting and aggression.[2-5] These explosive behaviors may result in injury or re-injury and prolong rehabilitation periods for horses on medically-mandated stall rest.[2]

Many unwanted behaviors can be resolved by limiting exposure to stressful situations, increasing pasture turnout, providing enrichment activities or retirement. These solutions, however, are often unrealistic for horses that cannot be removed from their anxiety-provoking lifestyle (equine athletes) or horses already in low-stress environments who still exhibit problem behaviors.[2,4] Numerous supplements, pharmaceuticals, devices (cribbing collars, hobbles) and surgery have been advocated to modify poor behavior associated with showing, transport, riding and housing destruction (i.e. wood chewing, kicking walls).[6,7] These treatments, however, have variable efficacy along with safety concerns and mostly fail because the underlying cause is not addressed.[4] Additionally, the presence of these anxiety-related behaviors can indicate ongoing stress with welfare concerns which makes accurate, expedient diagnosis and treatment paramount for preserving the physical well-being of both horse and handler as well as the human-horse relationship.[2,4,8]

In traditional Chinese veterinary medicine (TCVM), anxious behaviors originate from disturbances of the *Shen*.[9-11] *Shen* is the Mind and responsible for mental

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clarity, rational thought and inner peace. It is housed in the Heart, therefore, imbalances in the Heart have potential to result in a *Shen* Disturbance.[9-11] Horses, being inherently *Yang* animals, are predisposed to disturbances of the Heart.[5]

Clinical signs of *Shen* Disturbance reflect pathological destruction of reason and may be mild, moderate or severe. Horses with mild *Shen* Disturbance may demonstrate behaviors such as restlessness, separation anxiety from the herd/barn, noise phobia, or anxiety in new environments. These are such common issues that they may not be immediately recognized by the handler as pathological.[4,5,10,11] Stereotypies are another common clinical manifestation of *Shen* Disturbance and as the incidence of the behavior increases, may be considered moderate behavior abnormalities. Stereotypies are defined as repetitive behaviors without an obvious function, such as weaving, cribbing, wind sucking and stall walking. While never observed in wild horse populations, stereotypies are reported in more than 15% of domesticated horses.[4] Riding disciplines with the highest reported prevalence of horses displaying these behaviors are dressage (32.5%), eventing (30.8%) and endurance (19.5%).[4] Severe *Shen* Disturbance clinically manifests as unpredictable/explosive movements, panic or mania.[5,10,11] Stabled horses may destroy blankets or bandages, show aggression towards handlers/other horses, kick stall walls, and extreme cases of *Shen* Disturbance may result in self-mutilation.[5,10]

Shen Disturbance may result from an Excess or Deficiency and is commonly categorized into 6 TCVM pattern diagnoses in horses.[10,11] Excess patterns include Liver *Qi* Stagnation, Phlegm Fire Flaring Upward and Phlegm Misting the Mind (Table 1).[10,11] These patterns are typically seen in young animals, appear acutely and are more severe.[10,11] Deficiency patterns include Heart *Yin* Deficiency with False Heat, Heart *Yin*/Blood Deficiency and Heart *Qi* Deficiency (Table 2).[10,11] These patterns are usually chronic with variable severity and occur more commonly in older animals.[10,11] An accurate TCVM pattern diagnosis must be determined for successful disease treatment (Figure 1). It is also important to combine the TCVM exam with a good physical exam as some horses in pain may present with behaviors similar to *Shen* Disturbance (i.e. horse with back pain bucking when ridden).

PATTERN DIFFERENTIATION AND TREATMENT

Liver *Qi* Stagnation

Liver *Qi* Stagnation is a common Excess pattern in horses. Many successful equine athletes are Wood constitutions, which predisposes them to development of Liver *Qi* Stagnation and by extension, *Shen* Disturbance.[11] The pattern presents with an acute onset of irritability or aggression and is propagated by stressful events including travel, change in herd dynamics, competition or injury.[11] The untreated Stagnation becomes Heat which ignites Phlegm and destroys *Yin* and Body Fluids (Figure 1).[10-12]

Table 1: Clinical signs and treatment strategies for Excess TCVM Patterns associated with *Shen* Disturbance.

	Liver *Qi* Stagnation	Phlegm Fire Flaring Upward	Phlegm Misting the Mind
Clinical Signs	Acute onset, irritability, aggression	Headstrong animal, hyperactive to manic, anxious, depression, stereotypies	Easily distracted with mental dullness, obtundation, severe fear, shivering, lack of confidence
Tongue	Red or purple, possible strawberry dots at Liver position	Red or deep red, Yellow coating	Pale, white coating
Pulse	Wiry, forceful, choppy or fast	Fast and surging	Strong, slippery, slow
Treatment Principle	Soothe Liver *Qi* and Calm the Mind	Clear Heat, transform Phlegm, calm the Heart, tranquilize the Mind	Transform and eliminate Phlegm
Acupuncture Treatment	LIV-3, LIV-14, GB-20, GB-34, GB-41, BL-18, BL-19, BL-43, BL-44, GV-20, *An-shen*, *Da-feng-men*	GV-14, ST-40, ST-44, HT-7, HT-9, PC-6, PC-9, SI-3, LIV-2, LIV-3, *An-shen*, *Tai-yang*, *Er-jian*, *Wei-jian*, *Da-feng-men*	*Bai-hui*, GV-4, ST-40, BL-20, BL-21, SP-1, LU-1, GV-26
Chinese Herbal Medicine	Liver Happy[a] (classical antecedent *Chai Hu Shu Gan Wan*) (Table 4)	*Zhen Xin San*[a] (Table 5)	*Wen Dan Tang*[a] (Table 6)

Table 2: Clinical signs and treatment strategies for Deficient TCVM Patterns associated with *Shen* Disturbance.

	Heart *Yin* Deficiency with False Heat	**Heart *Yin* and Blood Deficiency**	**Heart *Qi* Deficiency**
Clinical Signs	Strong fright, noise sensitivity, heat signs, increased thirst, sensitivity to touch	Flighty, poor memory, easily distracted, disturbed nocturnal behavior, poor sleep, dry hair coat	Head-strong, unable to focus, spook frequently, noise phobia, disturbed sleep
Tongue	Red, dry, crack lines, no coating	Dry, pale lavender, but may show dry, red tongue	Pale, wet, possible white coating
Pulse	Thin or thready, fast, weak (especially weak on the left side)	Thready and weak, (especially weak on the left side)	Weaker on the right side
Treatment Principle	Nourish *Yin*, clear Heat, calm *Shen*	Nourish Heart *Yin* and Blood, calm the Heart and tranquilize the Mind	Tonify Heart *Qi*, calm the Heart, and tranquilize the Mind
Acupuncture Treatment	HT-7, KID-3, SP-6, BL-15, BL-44, BL-23, *An-shen*, *Da-feng-men*	BL-14, BL-15, BL-17, BL-43, BL-44, HT-7, PC-6, KID-3, SP-6, SP-9, SP-10, ST-36, *An-shen*, *Da-feng-men*	*An-shen*, *Da-feng-men*, HT-7, PC-6, CV-17, LU-7, LI-10, ST-36, BL-14, BL-15, BL-43, BL-44, *Qi-hai-shu*
Chinese Herbal Medicine	*Er Yin Jian*[a] (Table 7)	*Shen* Calmer[a] (classical antecedent *Tian Wang Bu Xin Dan*) (Table 8)	Heart *Qi* Tonic[a] (classical antecedent *Yang Xin Tang*) (Table 9)

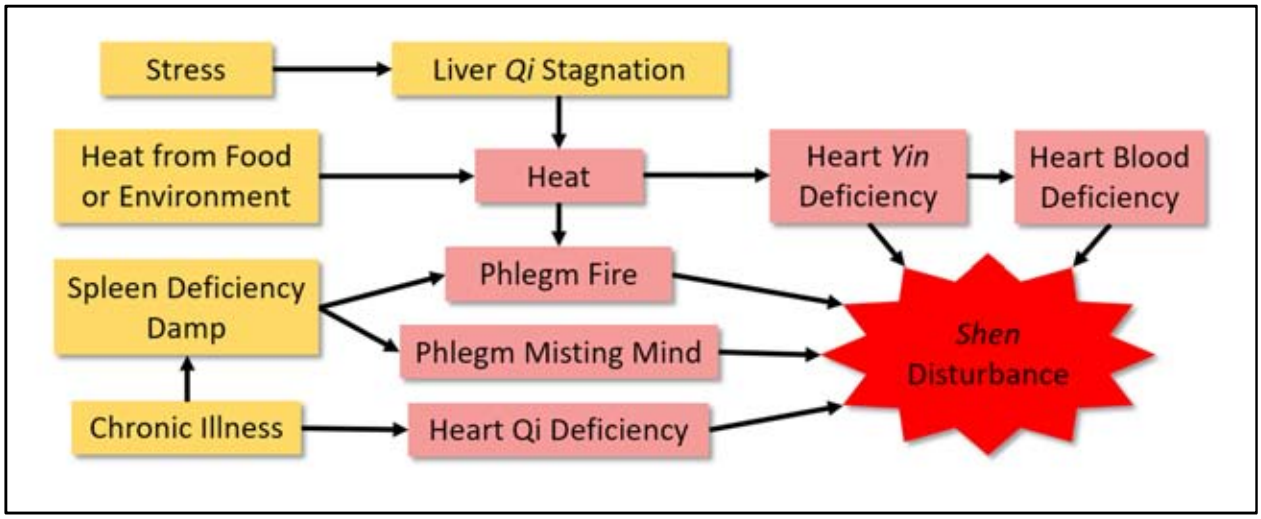

Figure 1: Flow chart of the relationship between contributing factors and the six pattern diagnoses of equine *Shen* Disturbance.

The TCVM examination usually identifies an animal presenting with signs of Heat.[10,11] The tongue is red or purple and may have "strawberry dots" along the lateral borders.[11] The sclera and conjunctiva may be injected and the typical pulse is wiry, forceful, and may feel choppy or fast.[11] The treatment principle is to soothe the Liver *Qi* and to calm the Mind.[11] Acupuncture points include: LIV-3/14, GB-20/34/41, BL-18/19/43/44, GV-20, *An-shen*, and *Da-feng-men* (Table 3, Figure 2).[11] The Chinese herbal medicine used for this TCVM pattern is Liver Happy[a] (classical antecedent *Chai Hu Shu Gan Wan*), which soothes Liver *Qi*, clears Heat, and resolves Stagnation (Table 4).[11]

Table 3: Acupuncture points for *Shen* Disturbance and their actions.

Acupoint	Attribute, Indications and Actions[11]
An-shen	Restlessness, hyperactivity, abnormal behavior, *Shen* Disturbance
Bai-hui	Permission, *Yang* deficiency, pelvic limb paresis or paralysis
BL-14	Back-*shu* Association point for PC, nourishes Heart and calms *Shen*, cardiovascular disorders
BL-15	Back-*shu* Association point for HT, nourishes Heart and calms *Shen*, cardiovascular disorders
BL-17	Influential point for Blood, nourishes Blood
BL-18	Back-*shu* Association point for LIV, Liver problems, seizure
BL-19	Back-*shu* Association point for GB, tendon/ligament problems, ear problems, foot conditions
BL-20	Back-*shu* Association point for SP, gastrointestinal disorders, diarrhea, edema, *Wei* syndrome
BL-21	Back-*shu* Association point for ST, gastrointestinal disorders, *Wei* syndrome
BL-23	Back-*shu* Association point for KID, nourishes *Yin*
BL-43	Nourishes Heart and calms *Shen*, anxiety, thoracic pain
BL-44	Nourishes Heart and calms *Shen*, cardiac disorders, thoracic pain, sleep disorders, cognitive dysfunction, epilepsy
CV-17	Front-*mu* Alarm point for PC, crossing point for SP, KID, SI, TH channels, cough, thoracic pain, tonifies *Qi*
Da-feng-men	Calms the Heart and *Shen*, sedation, Wind patterns, epilepsy, encephalitis, tremors, vertigo, hyperactivity
Er-jian	Clears Heat, fever, Wind-Heat
GB-20	Crossing point of the GB and *Yang-wei* Channels, external and internal Wind, cervical pain, epilepsy
GB-34	*He*-sea point (Earth), ST and LIV *Qi* Stagnation, hypertension, general pain relief, Liver and Gallbladder disorders
GB-41	*Shu*-stream point (Wood), Horary point, confluent point with the *Dai* Channel
GV-4	*Yang* deficiency, impotence, irregular heat cycles, thoracolumbar pain
GV-14	Clears Heat, tonifies *Yin*, epilepsy
GV-20	Permission point, crossing point of the GV and BL Channels, sedation, *Shen* Disturbances, epilepsy, sleep disorders
GV-26	Enhance *Qi* flow
HT-7	Calm the Heart and *Shen*, tonify Heart *Qi*
HT-9	*Jing*-well point, calms the *Shen*
KID-3	Nourish *Yin*
LI-10	Tonify *Qi*
LIV-2	Soothes and cools the Liver
LIV-3	Soothes and cools the Liver
LIV-14	Front-*mu* Alarm point for LIV, hepatic disorders, chest pain
LU-1	Front-*mu* Alarm point for LU, Lung Heat, dyspnea, immune regulation
LU-7	Tonifies *Qi*
PC-6	Calms the Heart and *Shen*, tonifies the Heart
PC-9	*Jing*-well point, calms the Mind
Qi-hai-shu	Tonifies *Qi*
SI-3	Opens the Governing Vessel, calms *Shen*
SP-1	*Jing*-well point (Wood), sleep disorders, excessive thinking
SP-6	Meeting point of the SP, LIV, and KID channels, nourishes *Yin* and Blood, sleep disorders
SP-9	*He*-sea point (Water), tonifies *Yin*, clears Damp

Table 3 cont.

SP-10	Nourishes Blood, clears Blood Heat and Heat Toxin, moves Blood Stagnation
ST-36	Tonifies *Qi*, immune-deficiency
ST-40	Influential point for Phlegm
ST-44	*Ying*-spring point (Water), clears Heat
Tai-yang	Clears Heat
Wei-jian	Clears Heat

Table 4: Ingredients of the Chinese herbal medicine Liver Happy[a] and their actions.

***Pin Yin* Name**	**English Name**	**Actions**[10]
Xiang Fu Zi	Cyperus	Soothes Liver, resolves Stagnation
Qing Pi	Citrus	Moves *Qi*, soothes Liver *Qi*, resolves Stagnation
Bai Shao Yao	Paeonia	Soothes Liver
Mu Xiang	Saussurea	Moves *Qi*
Bo He	Mentha	Moves *Qi*
Chai Hu	Bupleurum	Soothes Liver
Mu Dan Pi	Moutan	Cools Liver
Zhi Zi	Gardenia	Clears Heat
Dang Gui	Angelica	Moves Blood
Gan Cao	Licorice	Harmonizes

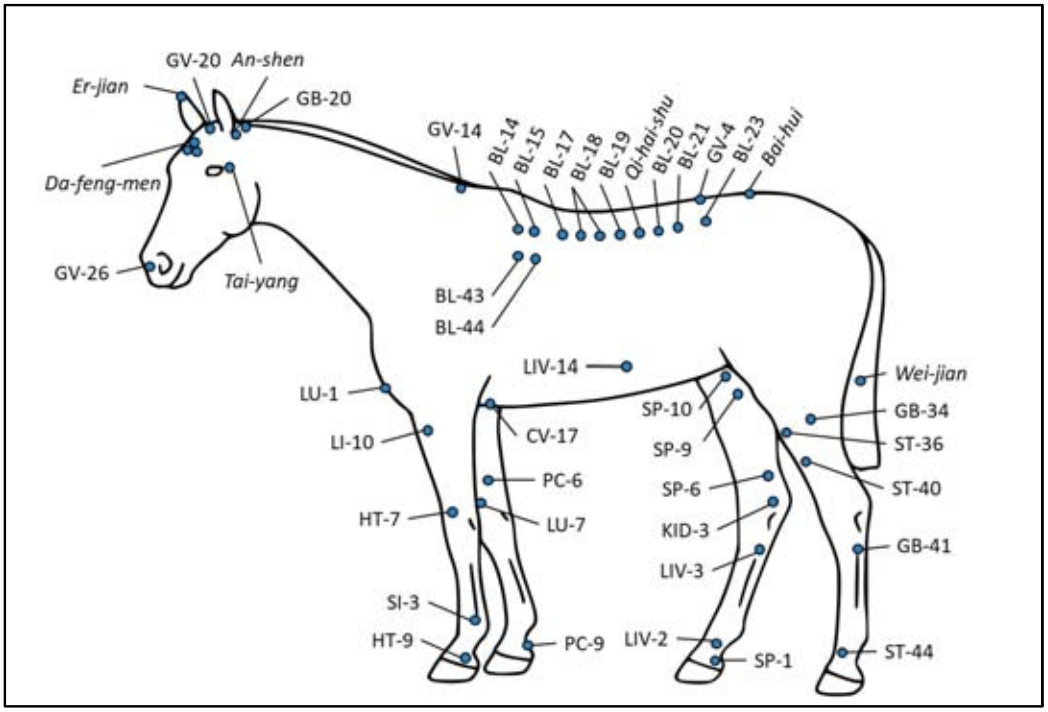

Figure 2: Illustration of the location of acupuncture points for the treatment of six common TCVM pattern diagnoses of *Shen* Disturbance in horses.

Phlegm Fire Flaring Upward

Phlegm Fire Flaring upward occurs when Heat consumes Phlegm and typically manifests as a head-strong animal that is hyperactive to manic (Figure 1).[11] These horses are anxious, restless, and display stereotypies (repetitive obsessive movements).[11]

On TCVM examination the tongue is red or deep red with a yellow coating that may be thick.[11] The pulse is fast and surging.[11] The treatment principle for this pattern is to clear the Heat, transform Phlegm, calm the Heart and tranquilize the Mind.[11] Acupuncture points for Phlegm Fire Flaring Upwards include: GV-14, ST-40/44, HT-7/9, PC-6/9, SI-3, LIV-2/3, *An-shen*, *Tai-yang*, *Er-jian*, *Wei-jian*, and *Da-feng-men* (Table 3, Figure 2).[11] The classical Chinese herbal medicine is *Zhen Xin San*[a], which clears Heat, transforms Phlegm, calms the Heart and tranquilizes the Mind (Table 5).[11]

Phlegm Misting the Mind

Phlegm Misting the Mind is Cold, in contrast to Phlegm Fire Flaring Upward. The root of this pattern is in chronic Spleen *Qi* Deficiency which allows Damp to accumulate and Phlegm to form (Figure 1). Horses with Phlegm Misting the Mind are easily distracted with mental dullness, obtundation and severe fear.[10,11] They may shiver and appear uneasy and lack confidence.[10,11]

The TCVM clinical exam identifies a pale tongue, possibly sticky with a white coating, indicating Damp.[10,11] The pulse is strong, slippery and slow.[10,11] Importantly, the pulse is not deficient. The treatment principle is to eliminate Phlegm.[11,12] Acupuncture points to treat this pattern include *Bai-hui*, GV-4, ST-40, BL-20/21, SP-1, LU-1, GV-26 (Table 3, Figure 2).[10,11] The classical Chinese herbal medicine used for this pattern is *Wen Dan Tang*[a], which eliminates Phlegm and moves *Qi* (Table 6).[10,11]

Heart *Yin* Deficiency with False Heat

Heart *Yin* Deficiency with False Heat is due to Heat destroying the Heart *Yin*.[11] The Heat may be exogenous or may be secondary to Liver *Qi* Stagnation (Figure 1). This pattern presents with strong fright, noise sensitivity, Heat signs (hot ears, breath, and body) and increased thirst, as well as extreme sensitivity to touch, especially on the ventral abdomen and medial aspect of limbs. This pattern may present similarly to Phlegm Fire Flaring Upward, but the root is deficient *Yin*, not Excess Heat.

The TCVM examination will identify a red, dry tongue with crack lines and no coating. The pulse is thin or thready, fast and weak, especially on the left. Treatment principles for this TCVM pattern include nourishing the *Yin*, draining Heat and calming *Shen*.[11] Acupuncture points for this pattern include HT-7, KID-3, SP-6, BL-15/44, BL-23, and *An-shen*, *Da-feng-men* (Table 3, Figure 2).[11] The best Chinese herbal medicine is *Er Yin Jian*[a], which nourishes *Yin*, drains Fire, and calms *Shen* (Table 7).[11]

Heart *Yin* and Blood Deficiency

Heart *Yin* and Heart Blood Deficiency typically present together. False Heat from Heart *Yin* Deficiency dries Body Fluids and results in Blood Deficiency.[11,12] Blood, in turn, fails to nourish the Heart and *Shen*, as does the deficient *Yin*, which leads to a *Shen* Disturbance (Figure 1).[11] Heart *Yin* and Blood Deficiency is one of the most common *Shen* Disturbance pattern diagnoses. Horses will be flighty and spooky with poor memory and are easily distracted. They are unable to obey commands and may have disturbed nocturnal behavior and poor sleep. The coat may be brittle and dry.

Table 5: Ingredients of the Chinese herbal medicine *Zhen Xin San*[a] and their actions.

***Pin Yin* Name**	**English Name**	**Actions**[10]
Dang Shen	Codonopsis	Tonifies *Qi*, calms *Shen*
Huang Qin	Chinese Skullcap	Clears Heart Heat, detoxifies
Yu Jin	Tumeric	Cools Blood, clears Heat
Yuan Zhi	Polygala	Calms *Shen*, nourishes Heart
Zhi Zi	Gardenia	Clears Heat, detoxifies
Fu Ling	Poria	Drains Damp, calms *Shen*
Fang Feng	Siler	Eliminates Wind and Wind-cold
Huang Lian	Coptis	Clears Heart Heat, detoxifies
Jiang Can	Bombyx	Transforms Phlegm, clears Internal Wind
Ban Xia	Pinellia	Transforms Phlegm
Tian Nan Xing	Chinese Arisaema	Transforms Phlegm
Zhu Ru	Henon Bamboo	Transforms Phlegm

Table 6: Ingredients of the Chinese herbal medicine *Wen Dan Tang*[a] and their actions.

***Pin Yin* Name**	**English Name**	**Actions**[10]
Ban Xia	Pinellia	Dries Damp, transforms Phlegm
Zhu Ru	Bambusa	Clears Lung Phlegm-Heat, clears Stomach Heat
Zhi Shi	Aurantium	Resolves *Qi* Stagnation in intestines
Ju Pi / *Chen Pi*	Citrus	Regulates Spleen *Qi*, dries Damp, transforms Phlegm
Gan Cao	Glycyrrhiza	Harmonizes
Fu Ling	Poria	Strengthens Spleen, drains Damp

Table 7: Ingredients of the Chinese herbal medicine *Er Yin Jian*[a] and their actions.

***Pin Yin* Name**	**English Name**	**Actions**[10]
Wu Wei Zi	Schisandra	Astringently consolidates *Yin*
Mai Men Dong	Ophiopogon	Nourishes *Yin*
Sheng Di Huang	Rehmannia	Cools Blood, nourishes *Yin*, clears Heat
Deng Xin Cao	Soft Rush	Drains Heart Fire and clears Heat
Fu Shen	Poria	Calms *Shen*, strengthens Spleen
Xuan Shen	Scrophularia	Cools Blood and nourishes *Yin*
Chuan Mu Tong	Armand's Clematis	Drains Damp and clears Heart Heat
Huang Lian	Coptis	Clears Heart Fire and Heat
Gan Cao	Chinese Licorice	Harmonizes

Table 8: Ingredients of the Chinese herbal medicine *Shen* Calmer[a] and their actions.

***Pin Yin* Name**	**English Name**	**Actions**[10]
Mu Li (*Sheng*)	Oyster Shell	Calms *Shen*, subdues Liver *Yang*
Bai Zi Ren	Oriental Arborvitae	Calms *Shen*, nourishes Heart
Mai Men Dong	Ophiopogon	Nourishes Heart *Yin*
Suan Zao Ren	Jujube	Calms *Shen*, nourishes Heart
Yuan Zhi	Polygala	Calms *Shen*, nourishes Heart
Bai Shao Yao	Chinese Peony	Soothes Liver *Qi* and nourishes Blood
Dang Gui	Dong Quai	Nourishes Heart Blood
Xiang Fu	Cyperus	Soothes Liver *Qi*
Chai Hu	Bupleurum	Regulates Liver *Qi* and relieves stress
Dan Shen	Chinese Salvia	Invigorates Blood, dispels Stasis
Fu Shen	Poria	Calms *Shen*
Xuan Shen	Scrophularia	Cools Blood Heat
Ye Jiao Teng	Fo-ti	Calms *Shen*, nourishes Heart
Qing Pi	Tangerine	Soothes Liver *Qi*, relaxes costal tension
Wu Wei Zi	Schisandra	Consolidates

The horse at TCVM examination will have a dry, pale lavender tongue, although these horses may also present with a dry, red tongue. The pulse is thready and weak overall with greater weakness on the left. The treatment principle is to nourish Heart *Yin* and Blood, calm the Heart and tranquilize the Mind.[11] Acupuncture points include BL-14/43, BL-15/44, BL-17, HT-7, PC-6, KID-3, SP-6, SP-9, SP-10, ST-36, *An-shen*, and *Da-feng-men* (Table 3, Figure 2).[11] The best Chinese herbal medicine for this TCVM pattern is *Shen* Calmer[a] (classical antecedent *Tian Wang Bu Xin Dan*), which nourishes Heart *Yin* and Blood, calms *Shen* and soothes Liver *Qi* (Table 8).[11]

Heart *Qi* Deficiency

Heart *Qi* Deficiency is due to chronic illness that consumes *Qi* and is a progression from severe Spleen *Qi* Deficiency or Global *Qi* Deficiency (Figure 1). Horses with Heart *Qi* Deficiency are head-strong, unable to focus on the handler, and spook frequently with no discernible cause. They have noise phobia and disturbed sleep.

The TCVM examination identifies a pale, wet tongue which may have a white coating. The pulse is weaker on the right side and may be weaker in the Heart position, but not always. The treatment principle for this TCVM pattern is to tonify Heart *Qi*, calm the Heart, and tranquilize the Mind. Acupuncture points to treat Heart *Qi* Deficiency include: *An-shen*, *Da-feng-men*, HT-7, PC-6, CV-17, LU-7, LI-10, ST-36, BL-14/15/43/44, *Qi-hai-shu* (Table 3, Figure 2).[11] The best Chinese herbal medicine for this deficiency is Heart *Qi* Tonic[a] (classical antecedent *Yang Xin Tang*), which tonifies Heart *Qi* and invigorates Blood (Table 9).[11]

TREATMENT MODALITIES

Horses with *Shen* Disturbance may be difficult to needle, and considerations must be taken to ensure safety of the horse, handler and practitioner. Choosing an acupoint with calming effects as a permission acupoint, such as *An-shen*, *Da-feng-men* or PC-9 for initial needle placement, may result in a safer and more efficacious acupuncture session. The number of needles placed may be limited due to behavior, so placing the most desired acupoints near the beginning of a treatment is ideal. Electroacupuncture can be useful in these horses if they will tolerate additional stimulation.

If dry needle acupuncture is unobtainable due to dangerous behavior, consider the use of *Tui-na* techniques in combination with Chinese herbal medicine and food therapy prescriptions. If necessary, the horse may be sedated with an alpha-2 agonist to facilitate safe administration of aqua-acupuncture or to allow the placement of skin staples at *Da-feng-men* for continuous stimulation. In this author's experience, the use of sedation to facilitate dry-needle acupuncture anecdotally results in an approximately 30% decrease in efficacy.

Chinese herbal medicine is the strongest form of treatment for *Shen* Disturbance and as with any disease, the correct pattern diagnosis is vital for successful treatment. The formulas used for *Shen* Disturbance utilize heavy or descending herbs to anchor or sedate the *Shen* and light herbs to tonify and nourish the underlying deficiency.[10] In this author's experience, initial loading doses of 30 grams twice daily as a top dressing may be required to achieve results in severely affected horses. This dose can be continued for the first two weeks of therapy before reducing to a standard protocol of 15 grams twice daily, or as needed to balance the *Shen*.[10] Horses that are predisposed to *Shen* Disturbance may require herbal medicine long-term to maintain balance. Due to the length of treatment, it is important to ensure that the provided treatments abide by the governing body regulations for horses still participating in their competitive discipline.

Table 9: Ingredients of the Chinese herbal medicine Heart *Qi* Tonic[a] and their actions.

***Pin Yin* Name**	**English Name**	**Actions**[10]
Huang Qi	Astragalus	Tonifies *Qi*
Dang Shen	Codonopsis	Tonifies *Qi*
Fu Ling	Poria	Drains Damp, strengthens Spleen
Rou Gui	Cassia	Warms *Yang*
Wu Wei Zi	Schisandra	Astringently consolidates
Yuan Zhi	Polygala	Tonifies Heart
Bai Zi Ren	Oriental Arbovitae	Tonifies Heart
Chuan Xiong	Sichuan Lovage	Moves Blood
Dang Gui	Dong Quai	Nourishes Blood
Gan Cao (*Zhi*)	Chinese Licorice	Tonifies *Qi*

CASE EXAMPLE 1

A 5-year-old Quarter Horse gelding presented for performance issues and a challenging personality. The gelding was purchased by the current owner one year prior to presentation with the intent to use as a competition barrel horse. The horse, however, had not been ridden for 3 months prior to clinical exam due to his difficult personality under saddle and reluctance to perform. He lived with several other horses in a pasture and was top of the hierarchy. The horse was known to be needle-shy.

The TCVM clinical exam classified the horse as a strong mixed Fire/Wood constitution. During the exam he was excitable, vocalizing and difficult to safely handle. His tongue was dry and pale purple, accompanied by fast pulses slightly weaker on the left. The horse's ears and body temperature were normal. It was noted that the hooves were chipped and cracked.

Acupuncture point scan:
- +5/5 left LIV-13, LIV-14, GB-24, GB-27
- +4/5 bilateral BL-19 through BL-23

TCVM Diagnosis: *Shen* Disturbance due to Liver *Qi* Stagnation with Heart Blood Deficiency

Acupuncture Treatment:
- Dry needle acupuncture for 20 minutes (left side): LIV-1, LIV-3, GB-27, *Shen-shu*, *Shen-peng*, *Shen-jiao*
- In order to minimize the number of needles used in a needle shy horse, only acupoints on the left (side with greatest sensitivity) were treated

Chinese Herbal Medicine Therapy: Liver Happy[a] 20 grams by mouth twice daily for 2 months, then *Shen* Calmer[a] 15 grams by mouth twice daily for 1 month.

Other Recommendations: Complete 4 acupuncture treatments every 3 weeks and continue Chinese herbal medicine for 3 months.

Outcome: The owner reported that after the first treatment, the gelding was running his barrels faster and was easier to handle on the ground and under saddle. He continued to improve with each subsequent acupuncture treatment until he had a negative acupuncture point scan for the Liver Channel. Liver Happy was discontinued at this point and he was prescribed *Shen* Calmer. In total, he received four sessions of acupuncture and 3 months of Chinese herbal medicine. The horse's rideability increased to the point where he was willing to work and successfully compete. This culminated in the fastest barrel times the horse had produced in over a year.

CASE EXAMPLE 2

A 6-year-old Rhinelander gelding presented for noise phobia and dangerous behavior under saddle. The horse was bred and raised by the owner and weaned early. Over the past year, he had become more sensitive to sounds and had become unsafe in the event of unexpected noise, such as a barking dog. The gelding had only mild improvement with various earplugs, medications, behavior modification, lameness examinations and veterinary spinal manipulation. He had been empirically treated for back pain with acupuncture and Body Sore[a] in the past with no improvement. He was in training as a show jumper but had become increasingly sensitive to the noise of the stadium crowd. In the horse's last show, he had to be withdrawn because the owner was unable to get him into the ring due to the noise. In the last few months, he had become resistant to riding and was bucking off riders. The last time he was ridden prior to presentation, he had bucked off his rider and then attacked the rider on the ground.

The TCVM clinical exam classified the horse as Wood constitution. The gelding was anxious on examination, aggressive (kicking, biting) and avoiding touch. He had a pale, dry tongue accompanied by pulses which were strong and fast. He had a dry haircoat and his body was hot.

Acupuncture point scan:
- +3/5 BL18/19, BL-54 bilateral

TCVM Diagnosis: *Shen* Disturbance due to Heart Blood/*Yin* Deficiency with Liver *Qi* Stagnation

Acupuncture Treatment:
- Dry needle acupuncture for 20 minutes (bilateral): *Da-feng-men*, PC-9, HT-9, HT-7, BL-14, BL-15, BL-43, BL-44
- Aqua-acupuncture with vitamin B12 (1000mcg/mL, 5mL each acupoint, bilateral): *An-shen*, BL-10, BL-18, BL-19

Chinese Herbal Medicine Therapy: *Shen* Calmer[a] 40 grams by mouth twice daily for 1 month, then 30 grams by mouth twice daily for 2 months.

Other Recommendations: Complete 3 acupuncture treatments every 2 weeks and continue Chinese herbal medicine for 3 months.

Outcome: After the first acupuncture treatment and starting the Chinese herbal medication, the gelding was about 30% improved for noise phobia. Additionally, he had stopped attacking riders, although he was still bucking under saddle. After his second treatment, he was 70% improved with cessation of the bucking and improved ability to focus on his work. After his third treatment, he was back to stadium jumping. He continued to have strong opinions under saddle, but was safe for the owner to continue riding, training and jumping.

SUMMARY

Equine behavior is complex and anxiety-related behaviors can be difficult to manage with conventional medicine. Early recognition and effective treatment of *Shen* Disturbances by a veterinary clinician is essential to protect the wellbeing of horses and their handlers and preserve the human-horse relationship. Traditional Chinese veterinary medicine offers an additional treatment perspective for unwanted equine behavior and can be used as a sole treatment for mild behavior cases or part of a comprehensive program for horses with behavioral abnormalities which can endanger themselves and their handlers.

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FOOTNOTES

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The Use of Essential Oils in Traditional Chinese Veterinary Medicine: Small Animal Practice

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ABSTRACT
Essential oils (EO) have been used for medicinal purposes since ancient times. Advancing to the present day, these aromatic plant-based compounds are proving to effectively treat human medical conditions as well as promote physical and mental health in maintenance programs and are supported by a growing body of scientific literature. The EO's have a long history associated with traditional Chinese medicine (TCM) and exhibit the TCM functions characteristic of the Five Elements, *Yin* and *Yang* and Channel affinity. The use of EO's is growing in veterinary medicine and similar to humans, they can be administered by several routes which include inhalation (water based diffusers, nebulizers), topical (diluted, undiluted) and ingestion. It is important for safe use in domestic animals to be attentive to species differences, purity of the product, route of administration and concentration of the EO. This therapy is predominately used as an adjunct to both conventional medicine and traditional Chinese veterinary medicine (TCVM) therapy and allows increased treatment flexibility and efficacy for a variety of veterinary medical conditions.

Keywords: essential oils, medicinal properties, disease prevention, clinical application, certified pure therapeutic grade, Chinese herbal medicine, traditional Chinese veterinary medicine

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ABBREVIATIONS

BID	Twice daily
CHF	Congestive heart failure
CPTG	Certified pure therapeutic grade
EO	Essential oils
FCO	Fractionated coconut oil
FDA	Federal Drug Administration
IVDD	Intervertebral disc disease
Lbs	Pounds
LS	Lumbosacral
TCM	Traditional Chinese medicine
TCVM	Traditional Chinese veterinary medicine

Essential oils (EO) are naturally occurring low molecular weight plant-based hydrocarbon compounds found in plant parts (e.g. seeds, leaves, bark, stems, roots, flowers) (Figure 1).[1-3] These potent oils give plants their characteristic aroma and are complex mixtures of hundreds of compounds.[2,4] Around 3000 essential oils have been produced by using at least 2000 plant species.[5] Many factors including plant variety, genetic variation, plant nutrition, geographic location, climate, maturity, stress during growth and post-harvest drying/storage affect individual chemistry of each EO similar to medicinal herbs.[5] In addition, type of plant material, along with the extraction method determine yield and biological properties.[5]

These aromatic compounds are involved in a plant's unique defense system against predators and disease, along with providing an important role in the plant's reproductive system. Essential oils have broad proven medicinal properties that include: anti-inflammatory, antioxidant, analgesic, calming, antibacterial, antiviral, antifungal, antiprotozoal, antimutagenic, anticancer, immunomodulatory and energizing. They are produced from one of two extraction techniques; steam distillation or cold pressing (unique to citrus peel or rind oil) with terpenoids and phenylpropanoids as the major constituents that provide the characteristic aroma and biological properties.[1-3,5]

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HISTORY

The ancient Egyptians as early as 4500 BC were thought to be one of the first civilizations to use essential oils.[6] They were used for medicinal purposes as well as part of daily life. Some favorites were cinnamon, myrrh, sandalwood and frankincense. These were considered highly valuable and often purchased with pure gold.

Advancing approximately 2000 years, in China, scholars first recorded the use of essential oils between 2697-2597 BC during *Huang Di*'s reign in the *Neijing Suwen* (Yellow Emperor's Classic of Internal Medicine).[6] This classic text of Chinese internal medicine was the foundation for the principles that are presently used in traditional Chinese medicine (TCM) and traditional Chinese veterinary medicine (TCVM) today. The ancient Greeks and Romans used essential oils for aromatherapy, therapeutic massage, personal hygiene and medicine.[6] For example, myrrh blended into an ointment for battlefield use proved to be an effective remedy for preventing post injury infections due to its antimicrobial, anti-inflammatory and antiseptic properties. It is also noteworthy to mention that frankincense and myrrh were highly valued precious oils, as told in the biblical story of the three Magi who brought these gifts to the Christ Child. The history of essential oils is lengthy and fascinating.[1,6]

ESSENTIAL OIL CHARACTERISTICS

Essential oils are fat soluble and are rapidly absorbed through the skin. They can penetrate the cell membrane, where other substances (e.g. antibiotics) cannot. This gives them the unique capability to provide intracellular antibacterial and antiviral actions.[1-3] Findings from studies confirm that most essential oils are rapidly absorbed after dermal, oral or pulmonary administration and are usually metabolized by the kidneys or exhaled via the lungs.[7] These oils were found to be safe at low concentrations in humans.[5] In veterinary medicine, attention to species differences, routes of administration, purity of the product, and concentration used are important for safe use.[1-3,7]

Plants producing EO's belong to several genera and are distributed through approximately 60 families. Important families such as Apiaceae, Asteraceae, Lamiaceae, Myrtaceae, Poaceae and Rutaceae are well known for their ability to produce EOs of medicinal value.[5] Terpenoids and phenylpropanoids are the primary active constituents found in the various EO plant families. The Apiaceae family (e.g. coriander, cumin, anise, fennel, dill, celery, black caraway), are well known for their antibacterial, antifungal, anticancer and antiviral activities. Other genera such as the Lamiaceae family (e.g. oregano, sage, lemon balm, wild mint, peppermint, sweet basil, rosemary, lavender) are well-known for anti-inflammatory properties, antioxidant, anxiolytic, chemotherapeutic, antiviral, antimicrobial and antimutagenic.[7] Some members of this family are also useful for intestinal disorders and bronchitis (e.g. peppermint, rosemary, sweet basil, sage, oregano, lemon balm, *Lavandula* sp.).

Cinnamon oil, obtained from *Cinnamomum verum*, which is rich in eugenol, is an important member of the Lauraceae family (anti-inflammatory, antimicrobial, antimutagenic). In addition, other well-known families of interest include Myrtaceae known for antibacterial, antifungal, antitumor, anticancer and antiviral properties (e.g. clove, thyme, tea tree, nutmeg, eucalyptus) and the family of grasses (Poaceae) such as lemongrass oil,

Figure 1: Essential oils (picture to left) are naturally occurring plant-based hydrocarbon compounds found in plant parts such as leaves, roots, seeds, bark and flowers (picture to right). They give plants their characteristic aroma and are complex mixtures of hundreds of compounds.

citronella oil and palmarosa oils where the medicinally active components (citral, geraniol, geranyl acetate) show antimicrobial and anticancer properties.[5]

Anxiolytic Action

Lavender oil (*Lavandula angustifolia)* is the quintessential representative of EO use for anxiety reduction.[8] It has been shown to reduce excessive or agitated behavior, improve mood and reduce anxiety/depression through a number of studies. In addition, it has been found to reduce plasma cortisol and improve coronary blood flow velocity along with its relaxant effects. An interesting human study administered lavender orally (eliminated potential recognition of odor) and demonstrated decreased anxiety elicited by anxiety-provoking film clips. The anxiolytic effects of lavender oil have been confirmed in animal models.[8] Linalool, one of its major constituents exhibited a dose-dependent anti-conflict effect in mice. A different study demonstrated inhalation of lavender EO produced an anxiolytic effect in gerbils comparable with the anxiolytic drug chlordiazepoxide.[8]

A number of essential oils, in addition to lavender, are currently used to relieve anxiety, stress and depression. The anxiolytic EO's generally contain terpenoids (linalool, geraniol, citronella), monoterpene limonene or citral.[8] Some of the more common anxiolytic EO's include lavender (*Lavandula angustifolia*), rose (*Rosa damascena*), orange (*Citrus sinensis*), bergamot (*Citrus aurantium*), lemon (*Citrus limon*), sandalwood (*Santalum album*), clary sage (*Salvia sclarea*), Roman chamomile (*Anthemis nobilis*), and rose geranium (*Pelargonium* spp). Mechanism of action rodent model studies with lemon oil demonstrated anxiolytic effects possibly by modulating GABA-nergic, serotonergic and dopaminergic systems in the brain.[8] Of interest are two EO's derived from Chinese herbal medicines, *Angelica sinensis* and *Su He Xiang Wan.*[8,9] *In-vivo* rodent studies confirmed the anxiolytic effects of these two as well as other EO's and is an area of intense interest and rapid development.[8]

Anti-inflammatory and Antioxidant

Essential oils have anti-inflammatory activity. Several mechanisms of action have been documented such as: free radical scavenging ability, inhibition of lipoxygenase, prevention of leukotriene synthesis, COX-2 enzyme inhibition, repression of pro-inflammatory genes, inhibition of pro-inflammatory cytokines, interleukin-1β and tumor necrosis-α.[5] Of the various mechanisms of action known to be involved, the free radical scavenging /antioxidant effects have been considered particularly important for the anti-inflammatory activity of EO's. Overall, the order of efficacy among the EO's with good radical-scavenging and antioxidant properties in order are: clove > cinnamon > nutmeg > basil > oregano > thyme.[5] The terpenoids, phenols and flavonoids found in EOs are associated with the significant antioxidant effects. Eucalyptus, tea tree, rosemary, lavender, pine, clove and myrrh oils are all good examples of EO's that exert inflammation preventive abilities.[5]

Table 1: Essential oils and the Five Elements of traditional Chinese medicine.[12,13]

Element	Essential Oil
Wood	For Excess: lavender, Roman chamomile For Deficiency: rosemary, lemongrass General affinity: bergamot, mandarin, everlasting, grapefruit, sweet orange
Fire	Excess: geranium, German chamomile, lavender Deficiency: cinnamon leaf, melissa, neroli, rosemary General affinity: jasmine, bay laurel, rose, ylang-ylang
Earth	Excess and Deficiency: rosemary, patchouli, coriander, neroli General: frankincense, cardamom, myrrh, peppermint, marjoram
Metal	Excess: lavender, eucalyptus Deficiency: ravensara, tea tree, Scot's pine General: thyme, clary sage, spearmint
Water	Deficiency: ginger, Scot's pine, cypress, cinnamon bark, cedarwood General: juniper, thyme, geranium

Anticancer and Antimutagenic

Some plant molecules have been shown to inhibit cancer cell proliferation. For example, palmerosa oil is reported to interfere with membrane function, ion homeostasis as well as cell signaling events in certain cancer lines. It has been found to reduce the size of colon tumors through interference with DNA synthesis.[5] Terpenoid and polyphenolic constituents of EO's have demonstrated reduction in tumor cell proliferation through induction of cancer cell apoptosis. A hepatoprotective effect has been reported for nutmeg oil that is thought to be due to its main constituent, myristin. This component demonstrated increased apoptosis in malignant neuroblastoma cells.[5] Anticancer activities have been demonstrated by garlic essential oil, antiangiogenesis by *Atractylodes lancea* (Chinese herb), inhibition of primary liver cancer (turmeric) and protection against colorectal cancer (olive oil). Important proposed mechanisms behind antimutagenic activities of EO's include interference with mutation inducing DNA repair systems and induction of necrosis/apoptosis leading to cancer cell death. Studies have indicated that essential oils such as frankincense, with anti-tumor properties and citrus oils (e.g. lemon, lime, grapefruit) contain the compound d-limonene that has anti-cancer properties.[2,6,10,11]

Antibacterial, Antiviral and Antifungal Actions

Plant molecules are well known for their antibacterial activity. The primary mode of action is membrane destabilization with loss of integrity due to an EO's ability to easily permeate the cell wall due to their lipophilic nature.[5] The interference with proton pump activity with loss of ions and cellular contents leads to bacterial cell death. Additional mechanisms include denaturation of cytoplasmic proteins and inactivation of cellular enzymes leading to bacterial death. Plant EO's have exhibited broad spectrum activity against a number of gram positive and gram-negative organisms.[5] Many of the plant molecules are effective against drug sensitive as well as drug resistant bacteria and have activity against antibiotic resistant biofilms.[5] In general thyme, oregano, tea tree, cinnamon, lemon grass, bay, lemon-myrtle, clove and rosewood oils are the most active antimicrobials. Of interest, thyme, rosemary, peppermint, lemon grass, clove and bay oils have potential to prevent *Staphylococcus aureus* at $\leq 0.05\%$ and garlic, lemon myrtle and tea tree oils are very active against methicillin resistant *Staphylococcus aureus* (MRSA).[5]

In addition to antibacterial activity, EO's have demonstrated antiviral properties. Inhibition of viral replication has been associated with the presence of monoterpene, sesquiterpene and phenylpropanoid constituents of EO's.[5] Eucalyptus and thyme oils have demonstrated inhibitory activity against herpes virus while tea tree oil has shown significant efficacy in the treatment of recurrent herpes virus infection. Mechanism of action appears to be the ability of the EO to interfere with viral envelope structures so that viral entry into host cells is prevented. A mouse model study accented the *in-vivo* efficacy of clove oil to interfere with herpes virus induced keratitis. Other examples of antiviral activity include inhibition of respiratory viruses by eucalyptus and viricidal effect on influenza and herpes viruses by tea tree oils.[5]

Table 2: General TCVM energetics, of some of the essential oils which can be used to guide treatment protocols.[13]

Essential Oil	Energetics	Examples
Frankincense	*Yin*	
Myrrh	*Yang*	
Peppermint	*Yin*	
Spearmint	*Yin*	
Floral Oils	*Yin*	Roman chamomile, lavendar, rose, geranium
Spicy Oils	*Yang*	Cardamon, ginger, cinnamon
Citrus Oils	*Yin*	Bergamot, grapefruit, lemon
	Neutral	Orange
Herbaceous	*Yang*	Bay laurel, marjoram, rosemary, thyme
	Yin	Cypress
	Neutral	Clary sage
Woody	*Yin*	Sandalwood
	Yang	Atlas cedarwood

Various fungi and yeasts are susceptible to EO inhibition. The Apiaceae family has been shown to be active against Candida albicans with coriander having the highest activity followed by anise and then fennel.[5] Other EO's showing good antifungal activity included cinnamon, lemongrass, Japanese mint, ginger grass, geranium and clove oils. Growth of dermatophytes and spores are inhibited by EO's rich in phenylpropanoids like eugenol and the monocyclic sesquiterpene alcohols and activity has been demonstrated against organisms such as *Trichophyton rubrum*, *T. mentagrophytes*, *T. roseum*, *Microsporum canis* and *M. gypseum*.[5]

TRADITIONAL CHINESE MEDICINE AND ESSENTIAL OILS

Essential oils represent the Jing or essence of plants and have a long history associated with traditional Chinese medicine.[12] This includes the Five Elements, *Yin* and *Yang*, TCM functions and Channel affinity (Table 1).[13] For example, EO's can express *Yin* properties (more cooling, moist) such as peppermint and spearmint or be more useful for a *Yang* deficiency (cold body with lethargy) such as ginger, rosemary, cinnamon. Generally, they can be classified as predominately either *Yin*, *Yang* or neutral energetics for treatment of TCVM patterns (Table 2). The actions of essential oils, therefore, of moving *Qi* and Blood, cooling or warming the body are the same concepts and principles that are routinely used in traditional Chinese veterinary medicine (TCVM) treatment modalities (Table 3). In addition, there is considerable overlap with Chinese herbal medicine as many EO's are concentrated distillations of medicinal herbs. For the TCVM practitioner with an understanding of Chinese herbal medicines and their actions, TCVM pattern use of EO's will be familiar (Table 4).

As a general guide, practitioners new to EO's may find it helpful to use the part of the plant the oil is derived from to aid appropriate EO selection for their TCVM patient.[12] The peel generally produces oils that are light, cooling, more superficial effects (e.g. *Wei Qi*) and short-lived such as citrus peels. Oils from leaves, which are the majority of EO's, have more depth and longer-lasting effects than EO's from peels. Just as leaves are part of the upper and outer parts of a plant, these oils can benefit head, neck, chest and front limbs. Oils derived from needles (e.g. cyprus, pine) work with the Kidney as well as Lung. They particularly work well with oils

Table 3: Examples of essential oils that might be used to help restore balance in traditional Chinese medicine treatments.[12]

TCM/TCVM Function	Essential Oil Treatment
Clearing Heat	Lavender, Roman chamomile, ylang-ylang
Qi Stagnation	Lavender, lemongrass, rosemary, peppermint, spearmint, bergamot. mandarin
Blood Stagnation	Frankincense, Melissa
Tonify *Qi*	Ravensara, neroli, rosemary, Scot's pine, tea tree
Tonify *Yang*	Ginger, rosemary, cinnamon bark
Nourishing *Yin*	Geranium, ylang-ylang, rose, vetiver
Nourishing Blood	Carrot seed, Roman chamomile
Damp	Peppermint, rosemary, cardamom, lemongrass, lemon
Calm *Shen*	Lavender, geranium, vetiver

Table 4: Essential oils and veterinary specific Chinese herbal medicine formulas with similar therapeutic actions.

Essential Oil	Chinese *Pin Yin* Name	Actions	Chinese Herbal Medicine Formula[a]
Cassi	*Jue Ming Zi*	Clears Heat, brightens the eyes	Haliotis Formula
Myrrh	*Mo Yao*	Moves Blood, resolves pain	Body Sore
Citrus	*Chen Pi*	Moves *Qi* and relieves pain	*Wei Qi* Booster
Cinnamon	*Rou Gui*	Warms *Yang*	Heart *Qi* Tonic

derived from resins such as frankincense to help grasp the *Qi* for improved depth of respiration. Oils from flowers are usually the most expensive and are some of the most complex and nourishing EO's. They are usually calming, cooling and nourishing to the *Yin*. Roots provide the thickest/mucoid oils and are beneficial to the lower aspects of the body as well as *Jing* and Kidney. Oils from seeds are closely associated with Spleen, Stomach, Liver and Gallbladder and can aid transportation/transformation of the Spleen/Stomach along with alleviating Damp. Finally, oils derived from wood are base notes which benefit grounding/stability while EO's from bark provide protection (i.e. inhibits anything from accessing the interior).[12]

Channel affinity of an EO helps direct both appropriate selection for patient constitution as well as synergism for an acupoint prescription. Essential oils such as bergamot and chamomile have affinity for the Wood Element while Fire Element EO's would include lavender, jasmine and bay laurel (Table 1). Some EO's have functions that coincide with acupuncture points.[12] Lavender has a sweet and comforting aroma with a cooling effect on the nervous system. It is associated with Lung, Liver and Pericardium. Two primary functions of lavender are to promote the smooth flow of Liver *Qi* and have a calming effect on the *Shen*. For example, lavender and palmarosa oils have an affinity for PC-6 as the oils both calm the *Shen* and open the chest.[12] Acupoint selection for a TCVM pattern such as External Wind invasion, might include LU-7 and LI-4. The choice of a complimentary EO with similar actions would include eucalyptus. Other examples such as use of the Four Gates acupoints (LI-4, LIV-3) for treatment of pain/Stagnation would prompt the selection of *Qi* regulating EO's such as spearmint, bergamot and mandarin. Spearmint would be the most appropriate for LI-4 while bergamot and mandarin would be compatible with LIV-3.[14] Although there are few studies looking at EO use and TCM, in 2004 and 2006 there were studies conducted that demonstrated the efficacy of acupoint stimulation using acupressure with a lavender (*Lavandula angustifolia*) EO on short-term pain relief in humans with back and neck pain.[15,16]

CLINICAL USE OF ESSENTIAL OILS IN SMALL ANIMAL PRACTICE

Application Methods

There are three ways to use essential oils: topical application, inhalation (aromatic diffusers) and ingestion. Topical application most commonly includes putting the oil onto the palms of the hands that are then rubbed together and then used to lightly apply the EO along the bottoms of the paw pads, between the digits, on the ear tips or on the hairless regions of the ventral abdomen. The hairless areas are selected as administration sites as they provide for rapid absorption of the oils. The EO can be applied to the spinal area and in the author's experience optimally rubbed in against the grain of the hair, although other clinicians find it works well when applied in the direction of hair growth. The practitioner needs to be aware of which EO's require dilution before application to the skin. Some EO's can be irritating and must be

Table 5: Essential oil dilution ratio table for dogs. To use the table refer to letters in the left column which represent various essential oils. Then refer to the dog's body weight in the middle column and then recommended dilution in the column on the right. The dilution values used in this table are conservative. Reference: Dog EO Usage Guide found at dogoiler.com

Essential Oil Code	Dog Weight	Essential Oil: FCO Dilution
A		1 Drop with No Dilution
B	Under 50 lbs	1 Drop: 8 Drops FCO
	Over 50 lbs	1 Drop: 4 Drops FCO
C	Under 50 lbs	1 Drop: ¼ Teaspoon FCO
	Over 50 lbs	1 Drop: 8 Drops FCO
D	Under 50 lbs	1 Drop: ½ Teaspoon FCO
	Over 50 lbs	1 Drop: ¼ Teaspoon FCO
For dogs under 10 lbs, double the 50 lbs FCO dilution		

FCO=Fractionated coconut oil

Essential Oil Codes: Frankincense (A), Lavender (B), Copaiba (C), Digestive Blend (C), Myrrh (C), Lemon (D)

Table 6: Essential oil dilution ratio table for cats. To use the table refer to letters in the left column which represent various essential oils. Then refer to the cat's body weight in the middle column and then recommended dilution in the column on the right. The dilution values used in this table are conservative. Reference: Cat EO Usage Guide found at dogoiler.com

Essential Oil Code	Cat Weight	Essential Oil: FCO Dilution
A	Under 10 lbs	1 Drop: ½ Teaspoon FCO
	Over 10 lbs	1 Drop: ¼ Teaspoon FCO
B	Under 10 lbs	1 Drop: 1 Teaspoon FCO
	Over 10 lbs	1 Drop: ½ Teaspoon FCO
C	Under 10 lbs	1 Drop: 2 Teaspoons FCO
	Over 10 lbs	1 Drop: 1 Teaspoon FCO

FCO=Fractionated coconut oil

Essential Oil Codes: Frankincense (A), Lavender (B), Copaiba (C), Myrrh (C), Digestive Blend (C)

diluted with fractionated coconut oil (FCO) to prevent skin irritation, inflammation and discomfort (Tables 5 and 6). An example of one such oil is oregano. For localized skin lesions (i.e. cuts, bruises, rashes), the drops of oil can be directly applied to the lesion. For the same reasons, the eyes and ears should be avoided during topical application of EO's.

The next application method is aromatically diffusing the EO. There are two basic aromatic diffusers: 1) water based (add drops of oil to a quantity of water) or 2) nebulizer (oil quantity diffusing is controlled by a dial). Water based diffusers are very simple and easy to use. They are the most popular and recommended. Diffuse for only 10 minutes at a low rate for the first time. Normally the animal will tell you what is comfortable and what is not. When dispensed to the owner for use at home, instruct the owner to always leave the animal an exit from the diffusing area (Figure 2).[1,3,5]

Some EO's can be safely administered via ingestion by placing in liquids, food or veggie capsules. It is essential that the clinician has knowledge of which ones should not be given orally. For example, Deep Blue Oil[b] is not for internal use in contrast to Deep Blue Polyphenol Complex dietary supplemental capsules[b] which are safe for oral consumption. Reference books are available that provide EO dosing and oral safety information if oral administration is the application method selected for an EO.[2,3]

The Use of Essential Oils Combined with TCVM Treatment

Essential oils can be a stand-alone treatment but are more commonly used as an adjuvant therapy in veterinary medicine. Their unique medicinal properties can be used as part of the patient's treatment plan and provides therapeutic flexibility. For example, both peppermint and ginger EO's treat digestive disorders but a cold individual might derive greater benefit from the ginger EO (increase circulation, warm the body) while the hot animal may benefit from the cooling properties of the peppermint EO. For those patients that will not take Chinese herbal medicine formulas, EO use provides topical and/or aromatic application options.

In addition to augmenting TCVM treatment of pattern imbalances, EO's are used in clinical practice for immunomodulation due to their anti-inflammatory, antioxidant and anticancer effects. They can be used for both disease prevention as part of a health maintenance program or as an adjunct therapy in pets with existing disease (e.g. cancer, drug resistant infections, musculoskeletal pain).

For the TCVM practitioner, having a calming, relaxing environment for patients, clients, and staff optimizes performing acupuncture treatments. One of the treatment goals is to have a calm patient, as this helps increase session efficacy. Towards this end, the use of calming essential oils as either single oils (e.g. lavender) or blends (e.g. Balance or Adaptiv)[b] is recommended. Constant EO aromatic dispersion by a water diffuser in the exam room can be an effective method of application. For patients with marked anxiety, placing lavender on the bottom of the foot pads produces calm/relaxation in just a few minutes. This technique is especially effective when combined with the TCVM sedation acupuncture points of GV-20, *An-shen*, GV-14, and *Bai-hui.*

Essential Oil Safety

Essential oils are safe to use with dogs and cats but knowledge of the different types of EO's and their medicinal properties along with species differences are important. There are do's and don'ts with the use of essential oils just as there are with conventional medications and Chinese herbal medicines. For example, it is recommended due to potential toxicity in dogs and cats to avoid tea tree, birch and wintergreen EO's.[17] Additionally, cats should avoid peppermint and spearmint. If these oils, however, are mixed in a blend, diluted with FCO or diffused, they are safe to use for both species. Stimulating EO's (e.g. rosemary) should be used with caution in animals with low seizure thresholds and EO's that produce a warming sensation when applied topically (e.g. cassia, cinnamon, clove) should always be diluted prior to topical application to dogs and are not recommended for cats.[2,3]

Cats metabolize medications, fragrances, and chemicals differently from canines and humans, and are more sensitive to certain essential oils (e.g. tea tree). Due to their sensitivity, the use of topical essential oils in felines will require a higher dilution as compared to canines (Table 6). Essential oils are also being used in other species (avian, exotics, large animals) and the reader is advised to secure appropriate reference material to assure safety. Two references the author commonly uses provide detailed information on safe use of essential oils for animals.[2,3]

Essential oils are produced for a wide variety of industrial, agricultural and commercial purposes as well as medical use. Some degree of care, therefore, needs to be taken when purchasing EO's to ensure suitability for veterinary use. It has been scientifically proven that the purer the essential oil, the greater the therapeutic effects. Products using essential oils are not Federal Drug Administration (FDA) approved. There are no regulations, requiring EO products (e.g. lotions, soaps, candles, sprays, oils) to contain a specific percentage of an essential oil. This is important because synthetic compounds mixed with the essential oil products (referred to as adulterated essential oils) could be toxic to animals. For validation of the purity of an EO, the designation Certified Pure Therapeutic Grade (CPTG) was developed. This means the EO has undergone extensive testing by the essential oil company and a neutral third-party to verify the EO is CPTG. Purity matters when using essential oils and is important for safe use in a veterinary practice.[1,6,18]

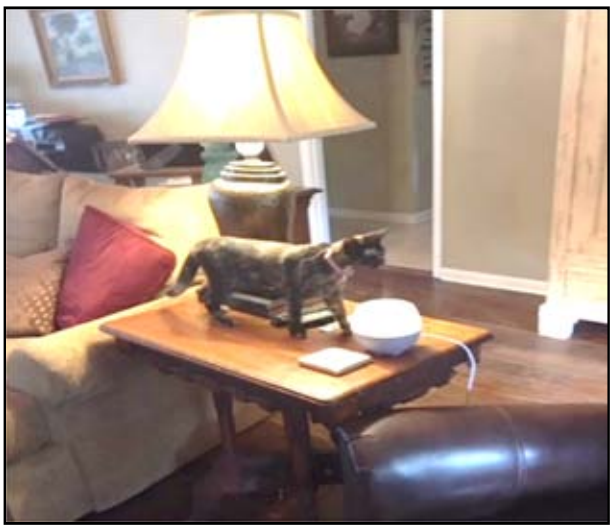

Figure 2: Cats metabolize medications, fragrances and chemicals differently from canines and humans, therefore, are more sensitive to certain essential oils (e.g. tea tree oil). As demonstrated in this picture, allow cats free access to the diffuser and the choice to leave the area.

CLINICAL CASE EXAMPLES

Case 1: Musculoskeletal stiffness and pain in a geriatric canine.

A 10-year-old, 65-pound (lb), spayed female Labrador Retriever was presented for significant musculoskeletal soreness and discomfort following periods of strenuous exercise (Figure 3). After rest with recumbency, she was reluctant to rise and moved with marked stiffness once up. Clinical physical examination was consistent with a tentative diagnosis of lumbosacral

Figure 3: A geriatric hunting dog (Case 1) with musculoskeletal stiffness and pain successfully maintained with essential oil and TCVM treatment.

(LS) osteoarthritis with marked musculoskeletal pain. The TCVM Pattern diagnosis was acute *Qi* and Blood Stagnation of the LS spine and Bony *Bi* syndrome (stiffness and pain). The dog was dosed with an EO blend[b] for the musculoskeletal pain until the clinical signs resolved which was 24-48 hours after treatment initiation (Table 7). Due to the chronic nature of this disease, the dog continues to be dosed intermittently with the EO blend when clinical signs recur. Resolution of the stiffness and discomfort associated with the LS Bony *Bi* syndrome usually takes 24-48 hours. This dog as well as other dogs using the EO blend in the author's clinic have had normal blood chemistries as well as no adverse side effects.

Case 2: Severe heartworm disease and congestive heart failure in an elderly canine.

A 9-year-old, 48 lb, female spayed Springer Spaniel diagnosed with congestive heart failure (CHF) with severe ascites was presented for evaluation. She was occult heartworm test negative and had been treated with conventional medications for CHF. In order to maintain an acceptable quality of life, the dog required weekly fluid removal by abdominocentesis to control her ascites. The TCVM clinical exam revealed a dog with great *Shen*, with a pattern diagnosis of Blood Stagnation of the Heart and Water Retention. Acupuncture and Chinese herbal medicine formulas were added to her treatment plan to help control her ascites. In addition to the TCVM treatment modalities, a combination of EO's were prescribed to address the severe clinical disease. These included frankincense (restore life source/*Jing*/*Qi*, support the cardiac system, calming), copaiba (anti-inflammatory properties, cardiac support), rosemary (support respiratory system, decrease coughing and lung infections), lavender (calming properties) and EO blend Breathe[b], (support respiratory system, open airways, reduce coughing).

This dog was referred to the Louisiana State University Veterinary Teaching Hospital for a cardiac evaluation, and was diagnosed with right side CHF and caval syndrome. Even though all serum heartworm tests were negative, heartworms were visualized in the heart and pulmonary vessels on echocardiogram. Removal of the heartworms by special surgical procedure was recommended, however, the procedure had a 50% mortality rate. The dog's owners declined the procedure. Since referral and diagnosis have been 3 years prior, this patient is still alive and clinically stable. Her current regime includes a prescription diet[c], furosemide[d] (5 mg tablet, BID), abdominocentesis every 4-8 weeks, and use of the EO's as needed. The author attributes the success of this case to the combination of treatment therapies/medications and the use of essential oils. This is a remarkable case as the estimated maximum survival time due to the severity of the heart disease with ascites, was only1 year using strictly conventional therapy.

Table 7: Essential oil ingredients in a blended product used for musculoskeletal pain.

Deep Blue Polyphenol Complex dietary supplement capsules[b] 1 capsule contains 875mg EO Blend	
Frankincense Gum Extract	Support muscle and joint comfort and function
Curcuminoids Complex (Turmeric) Root Extract	Standardized extracts of ginger, curcumin, resveratrol, and other polyphenols to soothe occasional aches and discomfort
Ginger Root Extract	
Green Tea Leaf Extract	
Pomegranate Fruit Extract	
Grape Seed Extract	
Resveratrol Root Extract	
Tummy Tamer Extract Blend (Ginger, Peppermint Leaf Extract, Caraway Seed Extract)	Blend of Peppermint, Ginger, and Caraway Seed to calm and soothe the digestive system
*Dose: 2 capsules BID for 67 lb dog (cases 1 and 3); smaller canines (< 25 lbs), 1 capsule BID	

Table 8: Ingredients present in a blended essential oil used for canine anxiety.

Adaptiv Calming Blend[b]	
Lavender	Stress-relieving effects
Magnolia	
Neroli	
Sweetgum	
Wild Orange	Energize and uplift
Spearmint	
Copaiba	Soothe anxious feeling
Rosemary	
Dose: 6-8 drops of oil /8oz of water *This formula should only be used in a diffuser	

Case 3: Canine with presumptive immune-mediated disease.

A 7 year-old, 38 lb, neutered male Beagle was presented for TCVM evaluation with clinical signs of lethargy, decreased appetite and intermittent vomiting of unknown origin. He had previously been evaluated by his regular veterinarian and an internal medicine specialist whose tentative diagnosis was inflammatory bowel disease. Although gastrointestinal issues were the primary problem at his initial TCVM consultation, the dog continued to require treatment for numerous clinical issues. These included cervical and lumbar pain, suspected intervertebral disc disease (IVDD), suspected meningitis of unknown origin and a retrobulbar abscess of the left eye. All his clinical issues, except for the suspected meningitis, responded well to a combination of conventional and TCVM treatments. The dog was stable for approximately two months, at which time the previous clinical signs returned and his medical condition deteriorated. His blood chemistries revealed significant increases in the alanine aminotransferase (ALT - 443U/L, reference range: 10-125) and alkaline phosphatase (ALKP - 1902 U/L, reference range: 23-212). His regular veterinarian discontinued the steroids and TCVM then became his primary medical treatment. These treatments consisted of acupuncture and Chinese herbal medicine based on TCVM pattern diagnosis. His clinical signs varied markedly with presentations of lumbar back pain (*Qi* and Blood Stagnation) all the way to head pressing with Heat signs (Heat Toxin). The patient responded well with acupuncture treatment (once weekly) and Chinese herbal medicine formulas (BID). In 6 weeks his clinical signs were under control and in an effort to help prevent future recurrence, EO use was recommended to the owner. With immune-mediated disease resulting in an inflammatory cascade suspected as the underlying clinical disease, the two EO's recommended were frankincense (immune and neurological support) and copaiba (anti-inflammatory properties). Two drops of each of these oils were placed in the dog's food twice daily. When painful episodes occurred (IVDD, headaches) rather than using conventional pain medications or steroids, the dog was given a dietary EO blend[b] (Table 7). Clinical response to this treatment technique (1 year) was effective as evidenced by the ability to taper the dog off Chinese herbal medicine and only requiring a single acupuncture treatment during the year. The dog continues to do well and any recurrence is treated with EO's.

Case 4: Anxiety treatment.

Essential oil use can help to promote calmness and relaxation in anxious pets. Lavender is especially effective and is used routinely in the clinic for anxious patients. For those pets who become anxious during car travel, especially long-distance travel, lavender again has proven to be effective. The recommended technique is to rub 2-3 drops in the hands and rub the bottom of 2 foot pads approximately 30 minutes before travel and then every few hours as needed. In the author's experience clients using this calming technique have been pleased

with the results.

Another recommended calming technique is to aromatically diffuse an EO blend in an animal's resting area several hours each day. A case example is presented of a multi-dog household (5 animals) with canine anxiety created by discord between the dogs. The client was instructed to aromatically diffuse an EO calming blend[b], in the dogs' resting areas a few hours each day (Table 8). After using the EO blend for two days, the owner noted an improvement in calm interactions between the dogs. The EO use in this multi-dog case appeared to decrease negative interaction between the dogs and resolve anxiety.

SUMMARY

Essential oils have been used for medicinal purposes since ancient times. They have unique characteristics such as rapid absorption thru the skin and ability to penetrate cell membranes due to their lipophilic nature. Findings from studies confirm that most essential oils are rapidly absorbed after dermal, oral or pulmonary administration and are usually metabolized by the kidneys or exhaled via the lungs.[7] These oils were found to be safe at low concentrations in humans. In animals, attention to species differences, routes of administration, purity of the product (CPTG oils) and concentration are important factors for safe administration. It is also important to note that the greater the purity of the oil, the greater the therapeutic effects and that contamination of oils can lead to adverse effects.

The clinical application of EO's are primarily as treatment for clinical disease, disease prevention and/or anxiolytic effects for anxious patients during acupuncture treatment. Application of EO's in veterinary medicine is commonly by direct application (diluted or undiluted) of a drop or two on the hands and smoothed onto the fur of the neck, back, feet or commonly added to a diffuser (water based or nebulizer) for inhalation therapy. There is a large body of EO research studies that have substantiated anxiolytic, analgesic, antioxidant, anti-inflammatory, immunomodulatory, antibacterial, antiviral, antifungal, anticancer and antimutagenic properties of EO's.

Essential oils have a long history associated with traditional Chinese medicine. Veterinary practitioners of Chinese medicine rely on specific TCVM patterns to guide acupuncture point and Chinese herbal medicine selection. Essential oils can be classified in a similar way by the Five Elements, *Yin* and *Yang*, TCVM patterns and Channel affinity. This allows the use of EO's to seamlessly integrate into a TCVM practice predominately as an adjuvant therapy or rarely as a stand-alone treatment based on TCVM patterns. It is hoped that as more veterinarians understand the benefits of this unique therapy, it will continue to gain popularity in veterinary clinics.

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FOOTNOTES

a. doTERRA essential oils, Pleasant Grove, UT, USA
b. Jing Tang Herbal, Ocala, FL, USA
c. Hill's Prescription Diet, H/D (Heart Care), Hill's Pet Nutrition/Colgate-Palmolive Company, Topeka, KS, USA
d. Furosemide (Lasix), 5 mg tablets, generic, USA

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Chinese Herbal Medicine Spotlight

Mai Wei Di Huang Wan (Ophiopogon, Schisandra and Rehmannia Pill)

Mai Wei Di Huang Wan (Ophiopogon, Schisandra and Rehmannia Pill), nourishes Liver and Kidney *Yin*, astringes Lung *Qi* and nourishes Lung *Yin*. This formula has similar actions as *Liu Wei Di Huang Wan* (Six-Ingredient Pill with Rehmannia). It also contains the herbs *Mai Dong* (Radix Ophiopogonis) and *Wu Wei Zi* (Fructus Schisandrae Chinensis) that give it a more specific ability to treat Kidney and Lung *Yin* deficiencies with clinical signs of dry cough, shortness of breath, constipation or dry feces, as well as the clinical signs of *Yin* deficiency found in *Liu Wei Di Huang Wan* (Six-Ingredient Pill with Rehmannia). The original source of *Mai Wei Di Huang Wan* is from the *Yi Ji* (Levels of Medicine).[1] *Mai Wei Di Huang Wan* is composed of the same six herbs as *Liu Wei Di Huang Wan* (Six-Ingredient Pill with Rehmannia). *Shu Di Huang* (Rehmannia), the chief herb, tonifies Kidney *Yin* and *Jing* (essence) and fills the marrow. *Shan Zhu Yu* (Cornus) nourishes the Liver and Kidney and astringes *Jing*. *Shan Yao* (Dioscorea) tonifies the Spleen and Kidney and consolidates *Jing*. Together, these three tonic herbs address deficiencies of the Kidney, Liver, and Spleen. *Ze Xie* (Alisma) sedates the Kidney, causes turbidity to descend, and controls the stagnating effect of *Shu Di Huang* (Rehmannia). *Mu Dan Pi* (Moutan) sedates Deficiency Fire of the Liver, as well as balances the astringent property of *Shan Zhu Yu* (Cornus). *Fu Ling* (Poria) strengthens the Spleen, resolves Dampness and balances *Shan Yao* (Dioscorea). It contains two additional herbs, *Mai Dong* (Radix Ophiopogonis) and *Wu Wei Zi* (Fructus Schisandrae Chinensis). *Mai Dong* tonifies *Yin*, moistens the Lungs, stops cough, strengthens Stomach *Yin* and generates fluids, clears Heart Heat, eliminates irritability and moistens the Intestines. *Wu Wei Zi* astringes leakage of Lung *Qi*, tonifies *Qi*, astringes *Jing*, nourishes Kidney *Yin*, stops diarrhea, astringes sweating, generates fluids, tonifies the Heart and calms the *Shen*. *Mai Wei Di Huang Wan* has similar applications as *Liu Wei Di Huang Wan* (Six-Ingredient Pill with Rehmannia) used to treat *Yin* deficiencies that develop secondary to many different conditions and diseases. It is one of the "*Di Huang Wan*" family of formulas. For more information on these deficiencies and how they are treated, refer to *Liu Wei Di Huang Wan*.[2]

Mai Wei Di Huang tonifies Kidney and Liver *Yin* and Kidney and Lung *Yin* deficiencies with clinical signs that include; dry cough, shortness of breath, constipation or dry feces, general weakness, irritability, dryness, insomnia, restlessness, panting excessively (especially at night), heat aversion, increased thirst, seeking cool surfaces/places, increased to ravenous appetite, increased thirst, trembling and jerking during sleep, soreness of the back and stifles, poor hearing or deafness, a red tongue body with no coating, and a rapid, thready pulse that is weaker on the left.

Veterinary conditions treated with *Mai Wei Di Huang Wan* include chronic bronchitis with dry cough in geriatric dogs, and for animals recovering from pneumonia with *Yin* deficiency. It is also a good choice for small breed dogs with concurrent Kidney deficiencies (CKD) and Lung deficiencies that develop secondary to chronic collapsing trachea with dry cough. Cats affected by chronic bronchial asthma with Lung and Kidney *Yin* deficiencies can be given this formula, and its effects can be enhanced by combining it with *Ren Shen Ge Jie San* (Ginseng and Gecko Powder) to improve its ability to resolve cough and stabilize asthma. *Mai Wei Di Huang Wan* can be used in the treatment and management of canine hypoadrenocorticism with Kidney and Liver *Yin* deficiencies, by adding *Huang Jing* (Rhizoma Polygonati), *Zhi Gan Cao* (Radix et Rhizoma Glycyrrhizae Praeparata cum Melle), *Gui Ban* (Plastrum Testudinis), *Tu Si Zi* (Semen Cuscutae) and *Gou Qi Zi* (Fructus Lycii). This formula can be safely given in combination with conventional drugs that include injectable mineralocorticoids (Percorten) or oral drugs (Florinef). *Mai Wei Di Huang Wan* is also used to treat various kidney diseases: 1) chronic glomerulonephritis in dogs, combine with *Tai Zi Shen* (Radix Pseudostellariae), *Sang Ji Sheng* (Herba Taxilli), *Yi Mu Cao* (Herba Leonuri), *Qian Shi* (Semen Euryales), *Huo Xiang* (Herba Agastaches), and *Dan Shen* (Radix et Rhizoma Salviae Miltiorrhizae; 2) severe proteinuria, add *Huang Qi* (Radix Astragali), *Yi Zhi Ren* (Fructus Alpiniae Oxyphyllae), and *Jin Ying Zi* (Fructus Rosae Laevigatae). Add *Xian Mao* (Rhizoma Curculiginis) and *Yin Yang Huo* (Herba Epimedii) for *Yin* and *Yang* deficiencies. This combination can be modified and given long term as needed. *Mai Wei Di Huang Wan* can also be used for the treatment of diabetes mellitus secondary to Kidney and Lung deficiencies.

Mai Wei Di Huang Wan is dosed twice daily until clinical signs resolve and the dose ranges by species as follows: horses and cattle 15-60g; camels 30-75g; llamas, alpacas, pigs, goats, sheep 5-15g; dogs 0.5-5g (or 0.1g per kg body weight); cats and rabbits 0.2-0.5 g (or 0.1 g per kg body weight); birds 0.1-0.2g per kg body weight.[3] *Mai Wei Di Huang Wan* should not be used in cases of cough with phlegm and should be used with caution in patients with cold diarrhea from Spleen *Qi* deficiency or *Yang* Deficiency.

Mai Wei Di Huang Wan has been shown to have marked hypoglycemic immunostimulant, adaptogenic, hepatoprotective and nephroprotective pharmacological effects, similar to *Liu Wei Di Huang Wan*. It has also been reported to have antitussive and expectorant properties. In a canine study, the use of *Mai Wei Di Huang Wan* was shown to have marked hypoglycemic effects when the plasma glucose level was between 180-350 mg/dl. It had little effect, however, when the plasma glucose level was above 350 mg/dl.[4] While the exact mechanism of this hypoglycemic effect is not well understood, it was determined that this formula does not increase plasma insulin levels, as it still had marked hypoglycemic effects in dogs whose pancreas had been surgically removed.[5]

Signe E Beebe DVM

Table 1: The ingredients of the Chinese herbal medicine *Mai Wei Di Huang Wan* (Ophiopogonis, Schisandra and Rehmannia Pill).[1-3]

***Pin Yin* Name**	**English Name**	**Amount (grams)**	**Actions**
Shu Di Huang	Rehmannia	24g	Tonifies Kidney *Yin* and *Jing*
Shan Yao	Cornus	12g	Tonifies *Qi*, drains Damp, nourishes Heart, calms *Shen*
Shan Zhu Yu	Chinese Yam	12g	Nourishes Liver and Kidney *Yin*
Fu Ling	Poria	9g	Drains Damp, strengthens Spleen
Ze Xie	Alisma	9g	Drains Damp
Mu Dan Pi	Moutan	9g	Clears Deficient Heat
Mai Dong	Ophiopogon	9g	Tonifies and astringes Lung *Yin*
Wu Wei Zi	Schisandra	9g	Tonifies and astringes Lung *Qi*, astringes *Jing*

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