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Retrospective Studies

Modified Scalp Acupuncture for Treatment of Central Nervous System Disorders in Dogs: A Retrospective Cohort Study

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ABSTRACT

Scalp acupuncture (SAP) has demonstrated efficacy for treating central nervous system (CNS) disorders. To improve SAP's practicality, while maintaining efficacy in dogs, a modified SAP (mSAP) technique was developed. The efficacy of mSAP when added to integrative therapy for CNS disorders above the foramen magnum (e.g. seizures, central vestibular disease, stroke/cerebrovascular accident) was evaluated in 46 dogs in a retrospective study. Dogs were categorized into 2 groups: Test (n=35) received mSAP and integrative treatment, and Control received integrative therapy without mSAP (n=11). Study dogs were assigned a neurological deficit/dysfunction score or seizure severity score before and after 45 days of treatment. Successful recovery was defined: 1) seizure frequency reduction by 2 grade levels or resolution of seizure activity or 2) neurological deficit improvement of 2 grade levels and/or return of ability to stand and walk without assistance. Time-to-recovery (TTR) data (in days) was recorded for dogs who met the criteria for recovery. The effect of mSAP treatment was compared to controls with respect to (1) recovery rate (%) and (2) mean TTR for those who recovered. Within 45 days, 34 out of 35 subjects (97.1%) in the Test Group met recovery criteria, compared to 63.6% (7/11) of the controls (p=0.009). The mean (SD) TTR in the Test Group was 6.7 (SD 6.2) days which was significantly shorter (p=0.001) than the Control Group mean of 21.0 (SD 12.1) days. Study findings suggest that adding mSAP to integrative treatment may shorten the recovery period for CNS disorders above the foramen magnum in dogs.

Keywords: integrative treatment, scalp acupuncture, seizure, stroke, vestibular disease, Wind-invasion, Wind-stroke, TCVM

ABBREVIATIONS: AP: acupuncture; CHM: Chinese herbal medicine; CNS: central nervous system; DNAP: dry needle acupuncture; EAP: electro-acupuncture; mSAP: modified scalp acupuncture; RCT: randomized controlled trial; SAP: scalp acupuncture; TCM: traditional Chinese medicine; TCVM: traditional Chinese veterinary medicine; TTR: time-to-recovery

Acupuncture (AP) has been used to treat a wide range of medical disorders in animals for over 4600 years (2600 B.C.).[1] Scalp acupuncture (SAP) is a contemporary specialized acupuncture technique which combines ancient dry needle acupuncture (DNAP) technique with Western medical knowledge of representative areas of the brain (i.e. scalp somatotopic system) rather than the traditional Chinese medicine (TCM) pathology principles of *Yin-Yang*, the Five Elements and Meridians.[2,3] This system, via stimulation of areas of the scalp, acts as a small window with access to the central nervous system (CNS).[2] Stimulation on the scalp has been shown to have direct effects on the cerebrum, cerebellum, thalamo-cortical circuits, thalamus, hypothalamus and pineal body.[2,3]

Scalp acupuncture has been used with success when treating disorders of the central nervous system in both humans and companion animals; examples include traumatic brain injury, regional pain, acute ischemic stroke, neurodegenerative diseases and motor neuron disease.[2] In stroke patients, where it is most commonly used in humans, it promotes healthy reintegration of lost cortical function. Two recent systematic reviews in humans confirmed significant motor dysfunction improvement in acute ischemic stroke patients after SAP treatment.[4] Of note, stimulation of SAP treatment lines result in measurable and observable changes by electroencephalogram (EEG) and functional magnetic resonance imaging (fMRI).[3,5,6] It has also been shown that SAP treatment significantly reduces levels of pro-inflammatory cytokines, such as TNF-α, IL-β and ROS (reactive oxygen species), in the hippocampus of experimental rats.[7,8]

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The SAP treatment lines or areas are believed to correspond to cortical functional zones (Figure 1).[2] There are 6 regular Meridians flowing directly into the head: Gallbladder (GB), Bladder (BL), Governing Vessel (GV), Triple Heater (TH), Liver (LIV) and Stomach (ST). The ST Meridian affects the frontal lobe, while TH and GB on the side of the head affect the temporal and parietal lobes. The BL and GV Meridians influence the frontal, temporal, parietal and occipital lobes; with the GV Meridian additionally providing access to the cerebellum and brainstem. The LIV Meridian connects to the eye system in the occipital lobe and runs up to the vertex.[2]

Using the regular Meridians along with transpositional and classical acupoints to define treatment locations, there are 3 main scalp treatment lines that are used when treating neurological dysfunction in canine and feline patients: 1) dorsal midline/top line, 2) sensory line, and 3) motor line (Figure 2).[3,5,9,10] Different from traditional DNAP, where one needle is inserted into a single acupoint, the SAP practitioner threads acupuncture needles subcutaneously along the scalp to stimulate whole treatment zone sections. This requires insertion of needles over the scalp region for a longer distance than is typical for DNAP single acupoint insertion, especially for the motor line (from GV-21 to TH-23).[3,5] Due to the large number of nerves and blood vessels along scalp treatment lines, needle placement with minimal discomfort is often difficult, even for skilled acupuncturists. Further, to enhance the positive effects, SAP requires repeated needle manual rotation and/or additional stimulation, such as electro-acupuncture (EAP) during treatment.[3,6,7] These limitations create challenges for successful use of SAP in dogs and cats, as these patients are less likely than humans to stay still during uncomfortable procedures; and the use of EAP is not recommended for some neurological conditions (e.g. seizure disorders, brain tumors, toxic disorders).[9,11,12]

To improve SAP's practicality for veterinary patients but still maintain effectiveness, a modified SAP (mSAP) technique was developed by the author (CW). When compared to classical SAP, the mSAP technique shortens both the motor and sensory lines, adds parallel motor lines to augment motor recovery, reverses dorsal midline needle insertion direction to provide sedation, extends the GV Meridian length, and replaces continued needle rotations (by hand or EAP) with lengthened duration of needle retention (Figure 2 and Table 1).[2,3,7,9,10] The duration of treatment (i.e. needle retention) can last from 1 hour up to 24 hours, depending on the severity of the neurologic disorder being treated. With the prolonged duration of needle stimulation, the mSAP technique is expected to extend the therapeutic analgesic effects and increase reduction of pro-inflammatory cytokines when compared to SAP treatment.[7,8]

Review of human and canine neurophysiology and neuroanatomy of brain and scalp provided the rationale for the proposed modified treatment lines for mSAP (Figure 3). These changes were made to decrease procedure discomfort, produce sedation, and intensify acupuncture stimulation of cortical motor areas and the GV Meridian coursing along the vertex. It is postulated that using mSAP provides advantages for small animal acupuncturists with improved comfort level for the patient and potential improved therapeutic effects that can enhance the recovery rate with quicker response to treatment. The objective of this retrospective study was to evaluate the efficacy of adding scalp acupuncture (modified technique) to TCVM integrative treatments for canine patients with CNS neurological disorders involving the brain. The hypothesis was that patients receiving TCVM integrative treatments, which included the addition of scalp acupuncture (modified technique), would have a shorter recovery time over a 45-day period, than those treated with TCVM integrative treatment without modified scalp acupuncture.

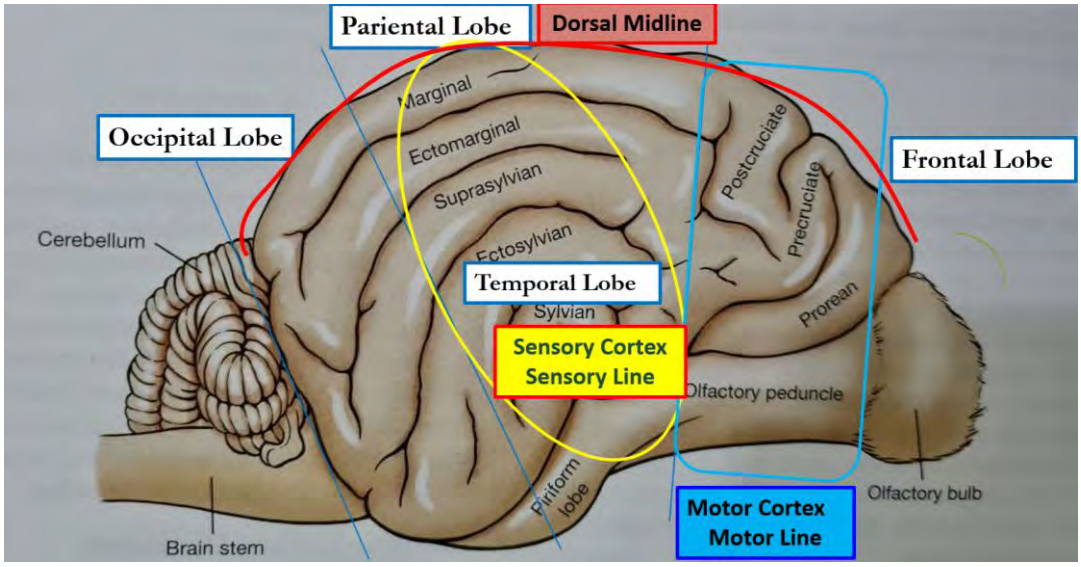

Figure 1: Cerebral hemispheres with frontal lobe, parietal lobe, occipital lobe and temporal lobe. The motor cortex area and sensory cortex area and their associated lobe are labeled. These areas are stimulated by SAP & mSAP treatment. (Image modified from: Evan H. Guide to Dissections of the Dog. 7th edition 2010: 267-270).[2,13]

Table 1: Comparison of scalp acupuncture (SAP) and modified scalp acupuncture (mSAP)[2,3,9]

	Scalp Acupuncture (SAP)	Modified Scalp Acupuncture (mSAP)
Top Line/Dorsal Midline	GV-21 to *Long-hui* Horizontal insertion toward the nose for tonification[10]	*Long-hui* to GV-17 Horizontal insertion away from the nose to promote sedation[10]
Sensory Line	GV-20 to *Nao-shu*	GV-21 to *Nao-shu* + *Nao-shu* acupoint
Motor Line	GV-21 to TH-23	GV-23 to GB-4 GV-24 to TH-23 GV-23 to GB-4: Indicated for paralysis in the opposite hind limb and whole trunk (upper 1/5 of the motor line).[2] GV-24 to TH-23: Indicated for forelimb paralysis (middle 2/5 of the motor line).[2]

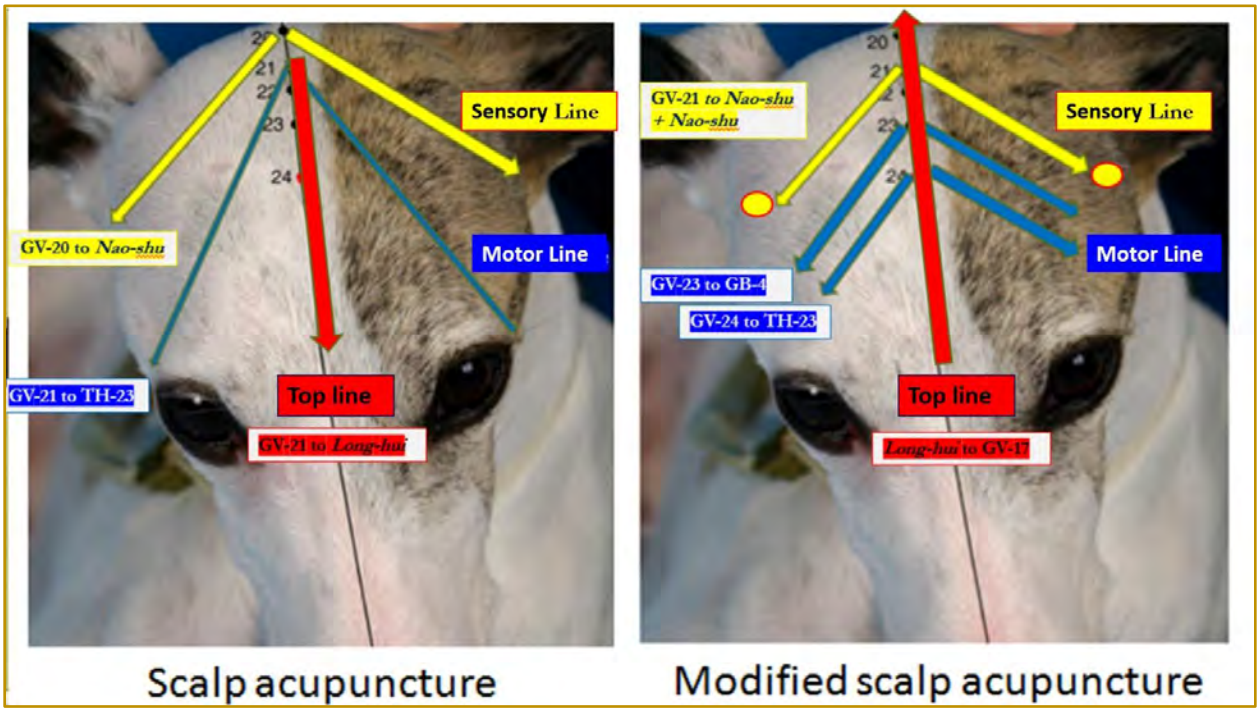

Figure 2: The picture on the left demonstrates the 3 classical "Scalp Acupuncture" (SAP) treatment lines: motor line (green-blue arrow), sensory line (yellow arrow), top line/dorsal midline (red arrow). The picture on the right demonstrates the changes proposed for modifying scalp acupuncture lines (mSAP) to improve procedure comfort while maintaining/improving efficacy. (Images modified from: Xie H, Preast V. Xie's Veterinary Acupuncture. Ames, Iowa: Blackwell Publishing 2007:199.)[2,3,9,10]

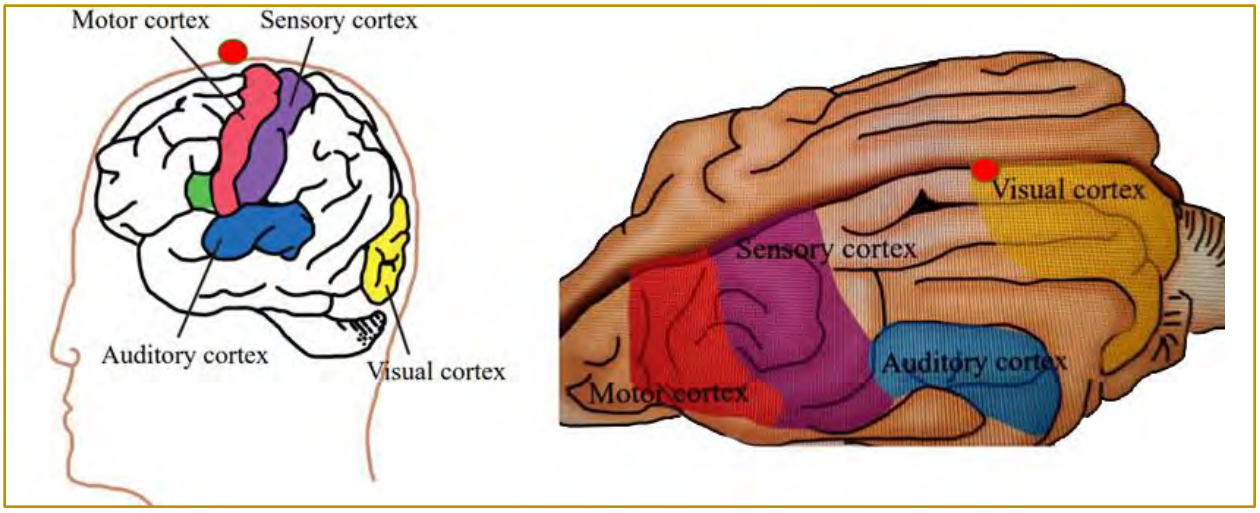

Figure 3: Anatomical structure difference between canine and human motor cortex and sensory cortex located in the frontal lobe and parietal lobe, respectively; based on GV-20 (canine) and *Bai-hui* (human) scalp region (red dot) locations. (Image modified from: Sivula N. Scalp acupuncture in dogs and cats. Am J Trad Chin Vet Med 2019; 14(2):71-80.)[2,13]

MATERIALS AND METHODS

Animals

All subjects included in this retrospective study were canine patients admitted to the Everise Veterinary Center (EVC), Kajang, Selangor Darul Ehsan, Malaysia, seeking treatment of CNS neurological disorders from 2013-2024. Criteria for study enrollment included the following: 1) canine patients of any age, sex, breed, body weight; 2) received a complete neurological exam with radiographs of the affected area; 3) clinical signs indicating a CNS disorder located above the foramen magnum (e.g. seizure, central vestibular disease, cerebrovascular disease); 4) treated with DNAP, Chinese herbal medicine (CHM), and Western/conventional treatment, with or without receiving mSAP treatment; and 5) with complete blood count and serum biochemistry tests performed. Patients with the following conditions were excluded: 1) died within the first 3 days of treatment; 2) received any of the following treatments: laser therapy, EAP, gold-bead implantation, stem cell treatment, corticosteroids/other immunosuppressive medications, or chemotherapy; 3) failing to follow up with the clinic after the second treatment; 4) admitted to EVC for second opinion and follow-up treatments; 5) with unknown history of previous medications; and 6) with acute or chronic otitis. Advanced imaging, such as an MRI or computed tomography (CT) scan, was not required in the diagnostic workup for study dogs as access to these procedures are limited and costly in Malaysia and only a rare owner consents to having these performed.

Data Extraction and Statistical Analysis

Data extracted from the medical records for each patient in this study included the subject's signalment (sex, age, body weight), comorbidities, grade of seizure disorder or neurological deficit/dysfunction before and after treatment, treatments received, and time-to-recovery (TTR) in days. For patients with seizure disorders, a seizure scale from 0-5 was used in this study according to the severity and frequency of the seizures (1=mildest, 5=most severe) (Table 2). For patients with other neurological disorders, a scale graded from 0 to 5 (1=mildest, 5=most severe) according to the severity of neurological dysfunction was used (Table 3).

Table 2: Seizure grade scores assigned to study dogs based on incident frequency

Severity Grade	Seizure Frequency
0	Seizure free
1	Once to several times per year
2	Monthly
3	Weekly
4	Daily
5	Hourly or non-stop seizure activity

The subjects meeting selection criteria were categorized into two groups based on the treatment received. All dogs had received acupuncture treatment once a day for the first 3-5 days of integrated treatment. The Test Group received mSAP treatment for the first 3 to 5 days in addition to integrative medicine treatment. The Control Group received DNAP for the first 3-5 days in addition to other integrative medicine treatments but without mSAP. The integrative treatment regime included Western/conventional treatments with TCVM treatments (DNAP, aqua-acupuncture, CHM).

The treatment outcome measurement for each patient was assessed by the time duration (in days) to recovery (TTR) within 45 days. Successful recovery (graded yes or no) for subjects with seizure disorder was defined as seizure frequency reduction by at least 2 severity grade levels or complete resolution of seizure activity, and for dogs evaluated by neurological dysfunction was defined as return of ability of the patient to be able to stand and walk without assistance (e.g. central vestibular disease, cerebrovascular disease) or reduction of 2 grade levels. The effect of mSAP treatment on level of recovery within 45 days was evaluated through the comparison of recovery rate (% of dogs that recovered) and mean TTR (for those who recovered) between the two treatment groups.

Group mean recovery duration (in days) was compared using nonparametric one-sided Wilcoxon Rank Sum test[a] to test the null hypotheses (H_0): two groups have the same mean recovery duration; versus alternative hypothesis (H_A): the mean recovery duration in the Test subject population is less than that in the Control subject population. Significance level 0.05 was used to conclude the statistical significance. Power analysis[b] estimated that 19 subjects in each group would provide a 90% power to reject the H_0 at a 0.05 significant level when the group difference of mean recovery duration equals the overall standard deviation.

Table 3: Grades assigned to study dogs based on neurological deficit/ dysfunction

Severity Grade	Clinical Presentation
0	No neurological signs
1	Mild neurological signs: able to walk, head tilted mildly, no nystagmus
2	Mild neurological signs: able to walk, head tilted mildly, low frequency of nystagmus
3	Moderate neurological signs: able to stand and walk, ataxic, head tilted severely with moderate frequency of nystagmus signs
4	Able to stand but cannot balance themselves, unbalanced with ataxic signs, circling and rolling, moderate nystagmus, head tilted severely
5	Recumbency, paresis or paralysis with neurological signs such as unilateral or symmetrical strabismus, high frequency of nystagmus, vomiting, anorexic, unable to stand and walk

RESULTS

Medical records from 1,063 patients with central nervous system disorders seeking treatment over an 11-year period were reviewed. Out of these cases, a total of 46 canine subjects with CNS neurological lesions considered above the foramen magnum, based on clinical signs, met study inclusion and exclusion criteria and were enrolled in the study. All dogs had been monitored for the first 5 days of treatment, with some dogs remaining hospitalized and others going home but returning to the clinic daily. They were also presented for recheck and treatment during the second week follow up. Dogs that had reached a grade of 0, did not receive acupuncture again after the first 3-5 days of AP treatment but did continue their Chinese herbal medicine for 2-4 more weeks. For patients with severe clinical signs (grades 4-5), both groups continued to receive weekly AP until they reached grade 0/no clinical signs of Wind or had improved by 2 grade levels over a 45-day period. The severely affected dogs remained on their CHM for at least 3 months. To evaluate the effect of mSAP on early recovery, the dogs' medical records for this study were followed for recovery or no recovery for 45 days (or until death) after clinic presentation.

There were 35 dogs placed in the Test Group (received mSAP) and 11 dogs in the Control Group (no mSAP). On subject's sex, 21 females (or 60%) were in the Test Group and 5 (or 45.5%) in the Control Group were female patients (p=0.494). The Test Group had a mean (SD) age of 10.7 (SD 4.1) years old and the Control Group had a similar mean age of 9.7 (SD 4.1) years (p=0.362). Mean body weight for the Test Group was 14.1 (SD 10.2) kg which was similar to the controls at 17.3 (SD 10.8) kg (p=0.208). Comparisons between the two treatment groups did not find a significant difference for subject dog signalment (Table 4).

All dogs at the time of initial presentation were judged to have a brain lesion above the foramen magnum which involved 3 etiologies: seizures, central vestibular disease, cerebrovascular disease. The Test Group had 29% (10/35) of the subjects affected with seizure disorders and the Control Group had 55% (6/11); p=0.154. The mean (SD) neurological grade at presentation for treatment was 3.6 (SD 1.0) in the Test Group and was 3.4 (SD 0.8) in the Control Group (p=0.822). Since these were geriatric dogs, they also commonly had comorbidities at the time of presentation (e.g. vertebral body arthritic conditions, blood borne diseases, renal/heart/liver disease, incontinence, chronic pancreatitis), but these clinical disorders were not the primary reason for presentation to the clinic at the time of the brain lesion diagnosis (Tables 5 and 6).

Table 4: Subject's signalment and baseline data

	Test	Control	*p*-value
Sex (% female)	21/35=60.0%	5/11=45.5%	0.494
Age (years)	10.7 (SD 4.1)	9.7 (SD 4.1)	0.362
Weight (kg)	14.1 (SD 10.2)	17.3 (SD 10.8)	0.208
Neurological grade	3.6 (SD 1.0)	3.4 (SD 0.8)	0.822

Table 5: Summary table of individual study dog clinical diagnoses or TCVM pattern and treatment recovery times

Control Group

Dog Number	Neurological Diagnosis	Neurological Score* Start of Tm	Neurological Score* End of Tm	Tm Success Yes or No	Treatment Recovery Time (TRT)	Comorbidities
1	Seizure (recumbent)	Grade 3	Grade 0	Yes	15 days	—
2	Stroke/CVA	Grade 2	Grade 1	Yes	30 days	—
3	Seizure	Grade 4	Grade 0	Yes	7 days	—
4	Stroke/CVA	Grade 4	Grade 0	Yes	5 days	—
5	Stroke/CVA	Grade 3	Grade 1	Yes	30 days	Asthma, difficult breathing
6	Seizure	Grade 3	Grade 2	No	NA	UI
7	Chronic seizures	Grade 4	Improved to Grade 2, then seizure again on Day 41	No	NA	AKD
8	Vestibular disease	Grade 3	Improved to Grade 1, then relapse to Grade 3 on Day 42	No	NA	UI, sprain left forelimb
9	Seizure	Grade 3	Grade 1	Yes	36 days	Trauma, ANP, Panadol/Tylenol poisoning
10	Seizure	Grade 3	Grade 2	No	NA	Thrombocytopenia
11	Wind-stroke	Grade 5	Grade 0	Yes	24 days	—

* Neurological grade determined from Table 2 (seizures) and Table 3 (neurological dysfunction) with treatment success considered improvement of 2 grade levels or resolution of clinical signs in 45 days. AKD=acute kidney disease, ANP=anaplasmosis, Tm=Treatment, UI=urinary incontinence.

Table 6: Summary table of individual study dog clinical diagnoses or TCVM pattern and treatment recovery times

Test Group

Dog Number	Neurological Diagnosis	Neurological Score* Start of Tm	Neurological Score* End of Tm	Tm Success Yes or No	Treatment Recovery Time	Comorbidities
12	Vestibular disease	Grade 3	Grade 1	Yes	1 day	Spondylosis cervical/TL, IVDD
13	Seizure	Grade 4	Grade 1	Yes	7 days	Paresis-all limbs
14	Stroke/CVA	Grade 3	Grade 1	Yes	11 days	Spondylosis TL
15	Vestibular disease	Grade 3	Grade 1	Yes	10 days	Spondylosis L, IVDD
16	Vestibular disease	Grade 3	Grade 1	Yes	5 days	Kidney disease
17	Stroke (recumbent)	Grade 4	Grade 0	Yes	5 days	Paresis all limbs
18	Stroke (hemiparesis left side)	Grade 4	Grade 1	Yes	37 days	Proprioception absent both forelimbs
19	Stroke / Vestibular disease	Grade 3	Grade 0	Yes	3 days	Pancreatitis
20	Stroke	Grade 4	Grade 1	Yes	4 days	Cervical pain
21	Seizure	Grade 5	Grade 1	Yes (mild circling when excited)	5 days	—
22	Seizure (recumbent)	Grade 4	Grade 0	Yes	3 days	—
23	Stroke (Wind-stroke)	Grade 3	Grade 0	Yes	1 day	CHF, TC
24	Brain lesion above foramen magnum [no PLR, constricted pupils, no withdraw reflex (L), head tilt (R)]	Grade 4	Grade 0	Yes	8 days	—
25	Seizure	Grade 3	Grade 0	Yes	4 days	—
26	Vestibular disease	Grade 2	Grade 1	Yes	7 days	—
27	Vestibular disease	Grade 4	Grade 2	Yes	5 days	HSA, hip DJD, spondylosis LS
28	Stroke (Wind-stroke)	Grade 3	Grade 0	Yes	5 days	Anemic, liver disease
29	Brain lesion above foramen (recumbent, neurological signs after hit by car)	Grade 5	Grade 0	Yes	6 days	—
30	Seizure	Grade 5	Grade 0	Yes	3 days	Anaplasmosis
31	Stroke Wind-heatstroke	Grade 3	Grade 1	Yes	1 day	—
32	Seizure	Grade 1	Grade 0	Yes	8 days	—
33	Stroke Wind-heatstroke	Grade 3	Grade 0	Yes	8 days	—
34	Seizure	Grade 4	Grade 0	Yes	7 days	—
35	Stroke Wind-heatstroke	Grade 2	Grade 0	Yes	2 days	Dirofilariasis, breathing difficult
36	Stroke (recumbent)	Grade 5	Grade 2	Yes	6 days	—
37	Stroke (lateral recumbency)	Grade 3	Grade 1	Yes	11 days	Spondylosis LS, CHF, pancreatitis
38	Seizure/Wind-heatstroke (history of distemper lateral recumbency)	Grade 5	Grade 2 Grade 0 (6 months later)	Yes	11 days	Ehrlichiosis, head shaking, myoclonus
39	Vestibular disease/Wind-stroke	Grade 4	Grade 1	Yes	2 days	Cervical IVDD
40	Stroke (recumbent)	Grade 3	Grade 0	Yes	4 days	TC, bronchitis/asthma
41	Vestibular disease lateral recumbent (L), nystagmus (L)	Grade 4	Grade 1	Yes	6 days	—

Table 6: cont

Test Group

Dog Number	Neurological Diagnosis	Neurological Score* Start of Tm	Neurological Score* End of Tm	Tm Success Yes or No	Treatment Recovery Time	Comorbidities
42	Vestibular disease nystagmus (L), head tilt (R), ataxia	Grade 4	Grade 0	Yes	12 days	Tracheal collapse, CHF
43	Seizure	Grade 2	Grade 0	Yes	12 days	Tendon rupture
44	Stroke	Grade 5	Grade 0	Yes	4 days	Spondylosis TL
45	Vestibular disease [nystagmus (R), head tilt (L)]	Grade 4	Grade 0	Yes	4 days	Anorexia
46	Seizure	Grade 5	Grade 4	No	NA	CKD, exposed Dengue fogging

*Neurological grade determined from Table 2 (seizures) and Table 3 (neurological dysfunction) with treatment success considered improvement of 2 grade levels or resolution of clinical signs in 45 days. PLR=pupillary light reflex, (L)=left, (R)=right, TL=thoracolumbar, L=lumbar, IVDD=intervertebral disc disease, TC=tracheal collapse, CHF=congestive heart failure, HSA=hemangiosarcoma, DJD=degenerative joint disease, LS=lumbosacral, CKD=chronic kidney disease.

Conventional and TCVM Treatment

All study dogs had received integrated medical treatment which consisted of both conventional and TCVM treatments for their brain disorder and any comorbidities. None of the patients had received corticosteroid treatment. The TCVM treatments included CHM and AP based on TCVM patterns associated with their CNS signs as well as comorbidities. Herbal medicine formulas used for all study dogs diagnosed with brain disorders included: 1) *Di Tan Tang*[c] for seizure patients (Internal Wind TCVM pattern); 2) Cervical Formula[c] and *Di Tan Tang* for vestibular disease; and 3) *Di Tan Tang* (to reduce Phlegm and Damp) for cerebrovascular accident/stroke/Wind-stroke. These CHM formulas were orally administered and dosed at 500 mg/10 pounds, twice daily.

In addition to CHM, all dogs received body acupuncture using DNAP and/or aqua-acupuncture techniques. Acupuncture sessions for all study dogs were started with hemo-acupuncture at *Wei-jian* (if needed for Excess Heat condition), which was then followed by DNAP for controls or mSAP followed by DNAP for the test dogs. Standard acupoints used and TCVM patterns treated for all dogs included: 1) Soothe Liver, clear Wind, tonify Blood: BL-17, BL-18, BL-19, BL-20, BL-23, BL-40, BL-60; 2) Tonify *Yin*: BL-23, KID-3; 3) Reduce Phlegm and Damp: ST-40, BL-20, BL-21; 4) Calming: *Bai-hui*, *Da-feng-men* (GV-21); 5) Gastrointestinal issues: GV-1; 6) *Qi*-Blood Stagnation, pain (treat with 4 Gates), clear Heat, soothe Liver: LIV-3, LI-4; 7) Tonify Blood to dispel Wind: BL-17; 8) Improve weakness in the hindquarters: BL-40, *Bai-hui*. Dogs diagnosed with cerebrovascular accident/stroke/Wind-stroke also had additional DNAP at *Jing-jia-ji*.

The Control Group had several acupuncture points stimulated on the head with DNAP (*Da-feng-men*, GB-20, *Nao-shu*) after initial *Wei-jian* treatment (hemo-AP), while the mSAP Group had DNAP at acupoints *Nao-shu* and GB-20 in addition to mSAP treatment. For the first 5 days of treatment, some dogs remained hospitalized (inpatient), while other dogs returned home with the owner (outpatient). For grade 4 and 5 inpatient dogs, mSAP needles were left in place for up to 24 hours. Outpatient dogs (grades 4 and 5) remained in the clinic all day with mSAP needles (up to 6 hours) monitored by a technician or owner, and then sent home, with some dogs keeping the needles in place while at home.

Time-to-Recovery

Within 45 days, 34 out of 35 subjects (97.1%) in the Test Group recovered, compared to 63.6% (7/11) of the control subjects achieving recovery (p=0.009). The mean TTR values for those who recovered were compared between the two treatment groups (Figure 4). The mean (SD) TTR in the Test Group was 6.7 (SD 6.2) days (median=5 days) and was 21.0 (SD 12.1) days (median=24 days) in the Control Group. The recovery time in the Test Group was significantly shorter than recovery in the Control Group (p=0.001). Post-hoc power analysis[b] under such a sample size and the same other statistical considerations suggested that the study had a 75% power to reject the H_0 at a 0.05 significant level.

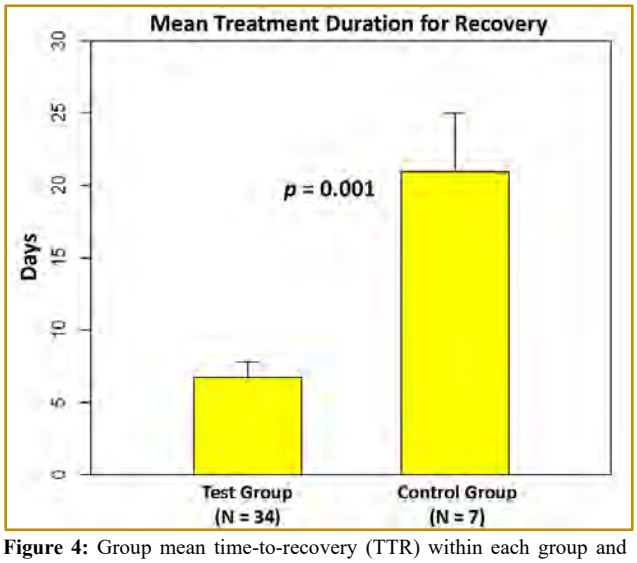

Figure 4: Group mean time-to-recovery (TTR) within each group and group comparison (only for patients who recovered); group difference was statistically significant (p=0.001).

DISCUSSION

The goal of this study was to determine whether canine patients with CNS disorders involving the brain, who received integrative treatment including mSAP, would have a shorter recovery time than those not treated with mSAP. Medical records of dogs presenting to EVC with neurological disorders over an 11-year period (1,063 patients) were reviewed. Enrollment of cases was based on selection of dogs presenting with CNS neurological disorders that were judged to be above the foramen magnum. A cohort of 46 patients that had received integrative medical treatment (TCVM + conventional) were selected, where 35 dogs had also received mSAP and 11 dogs were not treated with mSAP. Based on data collected from the 46 subjects, the study found that the group treated with mSAP had a significantly higher recovery rate (p=0.009) and significantly shorter mean recovery time (p=0.001) when compared to the group that did not receive mSAP treatment. These study findings support the hypothesis that the addition of mSAP to integrative therapy benefits neurological recovery for this patient population under the conditions of this study.

Similar to the present study, a number of clinical studies support the application of SAP in the treatment of brain disorders, and in particular stroke. A meta-analysis using 8 randomized controlled trials (538 patients) was conducted on the use of SAP for treatment of ischemic stroke in humans. Wang et al. showed significantly improved neurological deficit score and clinical effective rate in SAP treated patients compared to conventional treatment (pharmaceuticals).[14,15] In another meta-analysis (2,086 papers, 21 RCTs) evaluating the clinical effectiveness of SAP for stroke, it was concluded that SAP may significantly facilitate the recovery of motor and nervous function in patients with acute to chronic stroke.[15,16] A similar conclusion was reached from another meta-analysis revealing SAP improves motor function in patients with post-stroke hemiparesis; similar to dogs with this clinical presentation in the present study.[17] Another study (230 patients, 7 clinical trials) evaluating clinical outcome for acute intracerebral hemorrhage concluded that SAP treatment improved neurological deficit scores and appeared safe.[18] Literature has also cited its benefit in humans and dogs for brain disorders other than stroke such as treating canine stroke/fibrocartilaginous infarcts, head trauma, seizures, paresis/hemiplegia, senile dementia, Parkinson's disease, autism, and pain syndromes (acute or chronic).[2,3,5-12,14,15,19]

Explanations for the mechanism by which SAP benefits healing of CNS lesions vary.[15] Common potential mechanisms include: 1) stimulation of specific scalp areas excites a reflex somatotopic system corresponding to functional zones of the cerebral cortex, with effects transmitted to the cerebral cortex through nerves/Meridians; and 2) stimulating specific SAP lines/zones increases regional cerebral blood flow through stimulation of scalp trigeminal, facial and cervical nerves. There are studies that show that SAP stimulation significantly improves cerebral blood flow and the increased blood flow parallels the improvement seen when treating brain disorders.[20,21] Stimulation of the scalp in the area of the patient's brain near or proximal to disrupted neural tissue can directly increase the blood supply and tissue repair in that area.[15] Third, laboratory studies have demonstrated immunomodulation associated with SAP treatment. This treatment modality suppressed cytokine-mediated inflammatory reaction, suppressed reperfusion injury, and improved neuro-rehabilitation in animals with acute cerebral ischemia-reperfusion injury, as well as demonstrated modulation of leukocyte numbers.[15,22,23] With various SAP mechanisms promoted by investigators, it suggests that SAP may be a multifaceted process.

In the current study, commonly used SAP treatment lines and techniques were modified to decrease discomfort and improve recovery time. The 3 modified treatment lines included: 1) Dorsal midline (*Long-hui* to GV-17), needle directed caudally; 2) Sensory line (GV-21 to *Nao-shu* + *Nao-shu* acupoint); and 3) Motor line (parallel lines: GV-23 to GB-4 and GV-24 to TH-23).[3,10] In addition, constant manual rotation of the needles was eliminated and EAP was not used as it can be contra-indicated for some brain disorders.[9,10,19]

Review of neurophysiology and neuroanatomy of the brain and scalp provided the rationale for the proposed modified treatment lines for mSAP. Modification to the dorsal midline included lengthening the line to GV-17 and directing needle insertion caudally rather than cranially. By lengthening this line in a caudal direction, the acupuncture dose of the GV Meridian is increased, sedation increased, and the Crossing point for the GV and BL Meridians (GV-17) is added. The GV Channel is very important as it connects with all six *Yang* Channels (LI, ST, SI, BL, TH, GB); and connects all sensory and motor lines through the dorsal midline treatment region, extending from the frontal lobe through the parietal and temporal lobes, ending at the occipital lobe.[10] Directing the needle away from the nose, rather than cranially towards the nose, is associated with sedative effects which helps extinguish "Wind-invasion" for dogs with seizure activity and stroke victims, in addition to its calming effect. Of note, clinical studies in humans demonstrated the most significant cerebral blood flow impact occurred when GV-16 was needled and that GV acupoints on the head and neck were the most effective.[23]

The motor line, which was shortened and increased to 2 parallel lines, both improved procedure comfort by shortening the amount of tissue the needle advanced along; and it is proposed it augments the treatment effect on the frontal lobe which contains the motor cortex. Clinical studies have shown that applying SAP in the region of the scalp directly over the cortical motor area induced vasodilation with improved collateral circulation of cerebral vessels, as well as improved motor function for ischemic stroke cases.[15,22] In a different study, investigators demonstrated that multiple paralleled SAP needles could effectively increase blood flow volume.[24]

Similar to the motor line, the sensory line was also slightly shortened for comfort and stimulation augmented by placement of a second needle into the *Nao-shu* acupoint, affecting the parietal lobe which contains the sensory cortex.[3,5] Finally, this study eliminated continued needle manipulation and instead extended the length of time needles were left in place. It has been traditionally emphasized that repeated rapid rotation or lifting-thrusting of needles is necessary for successful SAP treatment. Two investigators demonstrated success without constant manipulation of needles. One study left needles in for a longer period without continued stimulation similar to the present study and the other study had a longer treatment course (increased number of sessions) and stronger stimulation (intensity). Both studies demonstrated clinical efficacy.[15]

Seizure, stroke and central vestibular disease were the three major conventional etiologies reported in this clinical study. From a TCVM perspective, these three etiologies are caused by the Wind Pathogen which leads to neurological disorders.[9,11,12] In TCVM, seizures belongs to *Nei-feng-zheng* or Internal Wind syndromes and are related to Phlegm, *Qi*/Blood Stagnation and Deficiency of *Jing* (Essence), *Yin* and Blood.[11,12] Stroke has been a recognized disease pattern in Chinese medical literature for at least 2000 years.[8-12,19] Stroke is also closely associated with Wind, hence the name *Zhong-feng* as Stroke by Wind or Wind-stroke.[19] "Wind-stroke" is a sudden reduction or loss of consciousness and neurological impairment from Wind invasion either Internal or External in origin. It is often associated with cerebrovascular disease with Wind-stroke causing Brain *Qi*/Blood Stagnation TCVM pattern diagnosis. From a conventional perspective Wind-stroke would be considered a transient ischemic attack (cerebrovascular spasms) or cerebral embolism.[3,11,19]

The third common diagnosis in this study, central vestibular disease, is related to Wind-Cold invasion causing Damp, Phlegm and local *Qi*/Blood Stagnation along with *Qi* Deficiency (Spleen *Qi* Deficiency or Kidney *Jing* Deficiency). Patients will show varying degrees of vestibular signs such as ataxia with loss of equilibrium, falling and rolling, unilateral or symmetrical nystagmus, head tilt, circling, and strabismus.[9,11] From a conventional perspective, central vestibular disease is related to brainstem involvement due to degenerative disease, trauma, brain tumor, infection, toxins, nutritional disorders, and vascular disease with either infarction or hemorrhage.[9,11]

Limitations to this study included the common challenges posed by retrospective studies: bias (e.g. selection of cases, recall, data mistakes), missing information, small sample size for conduct of a retrospective cohort study with a very small number of controls, and large variations in patient population which included grouping of a number of different brain disorders in this study. The lack of advanced imaging to precisely characterize and diagnose brain lesions was problematic as the 3 primary conditions diagnosed can have overlap of clinical signs. Most of the dogs in the study were middle-aged to geriatric so there were a number of confounding additional disease syndromes occurring at the same time as the brain disorder which may have caused inaccurate conclusions. Finally, mSAP was not compared to SAP in this study since none of the animals in the records reviewed had been treated with the traditional SAP treatment lines. It would be of interest in future studies to compare cases treated with SAP to cases treated with mSAP.

In conclusion, the current study found that the proposed mSAP treatment, when integrated with conventional and TCVM treatments, can shorten recovery times in canine patients with clinically diagnosed central nervous system disorders located above the foramen magnum. In addition, integrating mSAP into current integrative medicine treatments which include TCVM is practical, easily performed in a clinic situation, inexpensive as it does not require specialized equipment, and with few side effects. Further studies, particularly organized as randomized controlled trials, with a more uniform population and access to advanced imaging, are warranted to validate findings from this study and mSAP's efficacy.

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FOOTNOTES

[a] R version 4.2.1, R Foundation for Statistical Computing, Vienna, Austria

[b] G*Power version 3.1.9.4, The G*Power Team, Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany

[c] Dr Xie's Jing Tang Herbal Inc, Ocala, Florida, USA

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