J Vet Intern Med 2006;20:480–488

Effectiveness of Acupuncture in Veterinary Medicine: Systematic Review

Gabriele Habacher, Max H. Pittler, and Edzard Ernst

Acupuncture is a popular complementary treatment option in human medicine. Increasingly, owners also seek acupuncture for their animals. The aim of the systematic review reported here was to summarize and assess the clinical evidence for or against the effectiveness of acupuncture in veterinary medicine. Systematic searches were conducted on Medline, Embase, Amed, Cinahl, Japana Centra Revuo Medicina and Chikusan Bunken Kensaku. Hand-searches included conference proceedings, bibliographies, and contact with experts and veterinary acupuncture associations. There were no restrictions regarding the language of publication. All controlled clinical trials testing acupuncture in any condition of domestic animals were included. Studies using laboratory animals were excluded. Titles and abstracts of identified articles were read, and hard copies were obtained. Inclusion and exclusion of studies, data extraction, and validation were performed independently by two reviewers. Methodologic quality was evaluated by means of the Jadad score. Fourteen randomized controlled trials and 17 nonrandomized controlled trials met our criteria and were, therefore, included. The methodologic quality of these trials was variable but, on average, was low. For cutaneous pain and diarrhea, encouraging evidence exists that warrants further investigation in rigorous trials. Single studies reported some positive intergroup differences for spinal cord injury, Cushing's syndrome, lung function, hepatitis, and rumen acidosis. These trials require independent replication. On the basis of the findings of this systematic review, there is no compelling evidence to recommend or reject acupuncture for any condition in domestic animals. Some encouraging data do exist that warrant further investigation in independent rigorous trials.

Key words: Acupuncture; Alternative medicine; Complementary medicine; Systematic review; Veterinary medicine.

Acupuncture is a popular complementary treatment option in human medicine, and data indicate the substantial increase in prevalence.[1,2] It seems reasonable to assume, therefore, that owners also increasingly seek complementary and alternative medicine (CAM) for their animals. This notion is supported by the increasing number of studies investigating CAM in veterinary medicine and by coverage in the veterinary media.[3]

Acupuncture involves the stimulation of defined points on the skin typically by inserting needles. Related techniques such as electroacupuncture, laser acupuncture, or acupressure often are subsumed under this term.[4] The underlying principle of these therapeutic approaches is that disorders related to the flow of Chi or Qi (the Chinese word translated as 'vital force' or 'energy') can be treated by stimulating the relevant points on the body surface.[5,6] From a neurophysiologic point of view, the effects of acupuncture are, at least in part, mediated by a cascade of endorphins and monoamines.[6] Regardless of what may be the underlying mechanism of action, the most important question from a clinical standpoint is whether there are compelling data demonstrating its specific effectiveness. The aim of the systematic review reported here was to summarize and assess the clinical evidence for or against the effectiveness of acupuncture in veterinary medicine.

From the University of Veterinary Medicine Vienna, Veterinärplatz 1, 1210 Vienna, Austria (Habacher); and Complementary Medicine, Peninsula Medical School, Universities of Exeter and Plymouth, UK (Pittler, Ernst).

Reprint requests: Max H Pittler MD, PhD, 25 Victoria Park Road; Exeter, EX2 4NT, UK; e-mail: m.h.pittler@ex.ac.uk.

Submitted April 21, 2005; Revised August 23, October 14, 2005; Accepted October 24, 2005.

0891-6640/06/2003-0002/$3.00/0

Methods

Data Search

Searches were conducted by one of the authors (GH) to identify all controlled clinical trials (CCTs) of any form of acupuncture for any condition in veterinary medicine. The following databases were searched from their respective inception until May 2004: Medline, Embase, Amed, Cinahl, Japana Centra Revuo Medicina, and Chikusan Bunken Kensaku. The literature search was designed to retrieve all articles on the topic (terms: acupuncture, acupressure, electroacupuncture, laser acupuncture, veterinary medicine, and derivatives of these). In addition, we conducted hand searches of conference proceedings, bibliographies of all retrieved articles, and our own collection of papers. Seven experts in the field and 2 veterinary acupuncture associations were contacted and asked to provide further trials, particularly unpublished trials. There were no restrictions regarding the language of publication.

Inclusion/Exclusion of Studies

All CCTs, during which acupuncture by means of dry needles inserted into the skin, electroacupuncture, laser acupuncture, injections of distilled water into acupuncture points, gold wire implants or catgut insertion at acupuncture points or moxibustion was administered, were included by 2 of the authors (GH, EE). Studies that assessed clinical endpoints in domestic animals were included. Controlled clinical trials that tested acupuncture during experimental procedures or under induced clinical conditions also were included. Studies using laboratory animals such as mice, rats, rabbits, gerbils, hamsters, or guinea pigs were excluded, as were studies in which pharmacologic agents were injected into acupuncture points and duplicate publications.

Validity Assessment

The score initially described by Jadad et al[7] was modified for veterinary use and was used to provide an indication of methodologic quality. Studies were rated as blinded and received 1 point if the outcome was assessed in blind manner by a blinded observer. A 2nd point was given if the owner was blinded to avoid a transferred placebo effect on the animal. Studies were given additional points if reported as randomized and if the method of

randomization was described and appropriate. Another point was given for the description of dropouts and withdrawals, for a total of 5 points. The inclusion and exclusion of studies, data extraction, and validation, and the assessment of methodologic quality were performed independently by 2 reviewers (GH, EE). Disagreements in the evaluation of individual trials were largely attributable to reading errors, and were resolved through discussion.

Data Abstraction

Titles and abstracts of identified articles were independently assessed, and hard copies of all potentially relevant articles were obtained for further evaluation by all of the authors. Articles were read in full, and data were extracted systematically in a predefined, standardized manner according to design, diagnosis, number of subjects, and treatments for intervention and control groups (Table 1). Quantitative data synthesis was planned, but abandoned, because of the heterogeneity of the data.

Results

Fourteen randomized controlled trials (RCTs) and 17 non-randomized CCTs met all inclusion criteria (Table 1). Overall, the Jadad score in CCTs ranged between 0 and 1 point and in RCTs between 1 and 4 of a maximum of 5 points, suggesting variable, but on average, low, methodologic quality. For CCTs, acupuncture was tested in cattle, dogs, pigs, horses, and sheep; for RCTs, horses, dogs, and pigs were used. Eleven CCTs[8–18] and 7 RCTs[19–25] tested acupuncture during experimental procedures or under induced clinical conditions.

Musculoskeletal Conditions

Three musculoskeletal conditions were assessed in 4 RCTs (Table 1). For treating chronic laminitis or navicular disease in horses, electroacupuncture did not induce significant differences in stride length and weight distribution, compared with no treatment.[26] For treating wobbler syndrome in dogs, another RCT tested the effects of electroacupuncture.[27] That study indicated a larger cure rate in the intervention group, but no formal intergroup analyses were reported (Table 1). Goldwire and gold bead implants for hip dysplasia in dogs were tested in 2 further RCTs.[28,29] In both trials, the implants did not significantly improve the clinical signs of hip dysplasia, compared with results for control groups, in which the skin was pierced only superficially. A CCT assessed 3 types of acupuncture for treating chronic back pain in horses.[30] The results are difficult to interpret because of lack of a no-treatment or placebo control group. In another CCT, recovery time from induced spinal cord injury was significantly shorter in dogs receiving either conventional treatment or acupuncture, or a combination therapy, compared with no treatment.[18] These findings warrant replication in a rigorous RCT.

Visceral and Cutaneous Pain

Traditional acupuncture or electroacupuncture, applied at various sites across the body or as auricular acupuncture, was tested in 5 RCTs[22–25,31] and 4 CCTs.[8–10,32] Postsurgical pain after ovariohysterectomy was not significantly different among groups receiving ear acupuncture, buprenorphine, or no treatment.[31] Studies of induction of visceral pain in horses to test the effects of electroacupuncture indicated conflicting results.[22,23] Two CCTs[8,9] assessing induced cutaneous pain in horses also indicated conflicting results, whereas a further RCT[24] indicated beneficial intergroup differences (Table 1). A CCT assessing induced cutaneous pain in sheep[10] indicated beneficial effects for electroacupuncture. For other trials,[25,32] some effects were reported, but none detailed the results of intergroup analyses (Table 1). Methodologic quality of these trials was generally low. These data require further, more rigorous investigations.

Behavior

An RCT tested various acupuncture techniques for behavior modification in untamed ponies.[33] The results were varied, and the ponies behavioral responses were unaffected by acupuncture treatments. Statistical intergroup analyses were not reported.

Cushing's Syndrome

Recovery of adrenocortical function from iatrogenic Cushing's syndrome in dogs was assessed in an RCT testing electroacupuncture.[21] A significant difference in the increase of serum cortisol concentration before and after adrenocorticotropic hormone stimulation was detected in favor of electroacupuncture at point ST 36, compared with electroacupuncture at nonacupuncture points. These findings require independent replication in further RCTs.

Anesthesia

The effects of electroacupuncture on anesthesia were assessed in 2 RCTs.[19,20] For the decrement in the minimal alveolar concentration of isoflurane in dogs, intergroup differences were reported in favor of electroacupuncture, compared with electroacupuncture at nonacupuncture points.[20] For cardiovascular parameters, both RCTs did not find any intergroup differences (Table 1). Four CCTs from the same research group assessed cardiac output in dogs undergoing experimental halothane-induced anesthesia.[11,12,14,15] Comparisons with baseline indicated a significant increase in cardiac output when needling at GO 26,[11,14] whereas a decrease was detected at ST 36.[12,15] Intergroup analyses were not reported for any of the CCTs.

Reproductive System

The responsiveness to gonadotropin-releasing hormone (GnRH) in gilts treated with electroacupuncture was evaluated in 1 RCT.[34] Electroacupuncture was applied either 2 or 24 hours before GnRH administration. The effects were not clinically relevant at either 2 or 24 hours. Another CCT[35] assessed reproductive disorders in cattle. Although supporting statistical analyses were not reported, the authors stated that the best

Table 1. Controlled trials of acupuncture in veterinary medicine.

First author Year [reference]	Study Design Quality score	Condition N species	Intervention groups	Control groups	Main outcome measure	Intergroup difference for main outcome measure
Musculoskeletal conditions						
Bolliger 2002 [28]	RCT, parallel assessor / owner blind 4	Hip dysplasia 18 dogs	A: Gold bead implants at GB 29, GB 30 and BL 54 for 3 months	B: skin pierced at non-acupuncture points	Kinematic gait analysis	No intergroup difference
Hielm-Bjorkman 2001 [29]	RCT, parallel assessor / owner blind 4	Hip dysplasia 38 dogs	A: Goldwire implants at GB 29, GB 30 and BL 54 for 24 weeks	B: skin pierced at non-acupuncture points	Improvement of locomotion and reduction in signs of pain	No intergroup differences
Steiss 1989 [26]	RCT, parallel assessor blind 2	Chronic laminitis or navicular disease 20 horses and ponies	A: EA at Points 76, 84, 86 to 89 (chronic laminitis) B: EA at Points 14, 20, 23, 24, 27, 28-1 and 29-2 (navicular disease) 20 minutes 3 times/week for 4 consecutive weeks	C: No treatment (chronic laminitis) D: No treatment (navicular disease)	Combined clinical score (sum of six individual scores for walk and circling of both front legs)	No intergroup differences
Sumano 2000 [27]	RCT, parallel 1	Wobbler syndrome 40 dogs	A: EA along Jiu-Wei-points with or without surgery 30 minutes every other day until recovery	B: Orthodox medical treatment with or without surgery	Percentage cure rate	Not reported Cure rate in 85% of dogs in A and 20 % of dogs in B
Klide 1989 [30]	CCT, parallel 1	Chronic back pain 45 horses	A: Acupuncture for 20 minutes B: Laser acupuncture for 2 minutes C: Injection acupuncture (NaCl) Once a week for 2 to 17 weeks at different points	None	Alleviation of clinical signs	No intergroup differences
Yang 2003 [18]	CCT, parallel 0	Induced spinal cord injury 20 dogs	A: EA at GV 4 and ST 36 and acupuncture at GV 3, BL 23, BL 24, GB 30, GB 34, ST 40, ST 41 B: Combination of A and C 20 minutes every other day until recovery	C: Corticosteroids, cimetidine, misoprostol and Vitamin B1 D: No treatment	Days until recovery of conscious proprioception	P <0.05 for A or B or C compared with D P < .05 for B compared with A or C or D No intergroup differences between A and C
Visceral and cutaneous pain						
Merritt 2002 [22]	RCT, cross-over assessor/owner blind 3	Induced colic 5 horses	A: EA at 20 Hz at BL 21 B: EA at 80:120 Hz at BL 21 25 minutes during the experiment	C: EA at 20 Hz at non-acupuncture point D: EA at 80:120 Hz at non-acupuncture point E: No treatment	Frequency of clinical signs	No intergroup differences
Skarda 2003 [23]	RCT, cross–over 1	Induced controlled rectal distention 8 mares	A: EA at BL 21, BL 25, BL 27, GV 5 and ST 36 120 minutes throughout experiment	B: Butorphanole tartrate C: NaCl	Rectal pain threshold	P < .05 in favor of A or B compared with C

Table 1. Continued

First author Year [reference]	Study Design Quality score	Condition N species	Intervention groups	Control groups	Main outcome measure	Intergroup difference for main outcome measure
Visceral and cutaneous pain (continued)						
Skarda 2002 [24]	RCT, cross-over 1	Induced cutaneous pain 8 mares	A: Acupuncture at BL 18, BL 23, BL 25 and BL 28 B: EA at BL 18, BL 23, BL 25 and BL 28 120 minutes throughout the experiment	C: Not penetrating needle placement	Cutaneous pain threshold	$P < .001$ in favor of A or B compared with C
Still 1998 [31]	RCT, parallel assessor blind 2	Midline ovariohysterectomy 30 dogs	A: Auricular EA 15 minutes before and during surgery	B: Buprenorphine C: No treatment	Post-anaesthetic pain and distress	No intergroup differences
Wright 1981 [25]	RCT, parallel 1	Experimental midline abdominal incision 17 dogs	A: EA at ST 36 and SP 6 after acetylpromazine premedication B: EA at ST 36 and GB 34 after acetylpromazine premedication 40 minutes before and 20 minutes during surgery	None	Behavioral response during surgery	Not reported 'clinically useful analgesia' in 2 of 8 dogs in A and 8 of 9 dogs in B
Bossut 1983 [8]	CCT, cross-over 0	Induced cutaneous pain 23 horses	A: EA at Ba Shan B: EA at Ba Shan and Yao Pang C: EA at San Yang Lu 20 minutes induction time and 40 minutes throughout the experiment	D: No treatment, blood samples taken only E: No treatment; not further reported	Analgesia index	No intergroup differences
Bossut 1983 [9]	CCT, cross-over 0	Induced cutaneous pain 23 horses	A: EA at Ba Shan B: EA at Ba Shan, Bai Hui and Yao Pang C: EA at Qian Feng and San Yang Lu 20 minutes induction time and 40 minutes throughout the experiment	D: No treatment	Average analgesia index	$P < .05$ in favour of A or B or C compared with D (except A for male horses)
Bossut 1986 [10]	CCT, cross-over 0	Induced cutaneous pain 26 sheep	A: EA at Yao Pang and Bai Hui pre-, post-naloxone B: EA at San Yang Lu, Qiang Feng and Ye Yan pre-, post-naloxone 15-20 minutes throughout experiment	C: No treatment and no pain stimulation D: No treatment with pain stimulation pre-, post-naloxone	Pain threshold	$P < .05$ in favor of A compared with D and B compared with D
Kim 2004 [32]	CCT, parallel 0	Surgery for different indications 20 cattle	A: EA at dorsal acupoints (GV 20, GV 5) B: EA at lumbar acupoints (BL 21, BL 23, BL 24, BL 25) C: EA at dorsal-lumbar acupoints (BL 21, BL 23, BL 24, GV 5) EA stimulation was continuously throughout surgical procedure	D: EA at non-acupuncture points	Analgesic effect	Not reported

Table 1. Continued

First author Year [reference]	Study Design Quality score	Condition N species	Intervention groups	Control groups	Main outcome measure	Intergroup difference for main outcome measure
Behavior						
Hwang 1981 [33]	RCT, parallel 1	Behavior of untamed ponies 21 ponies	A: Clips stapled at Kai Kuan and scutiform point B: Hypodermic needles at Wonder and Lung point 1 C: EA at Kai Kuan and scutiform point D: EA at Wonder and Lung point Nr. 1 15 minutes before behavioral test	E: No treatment	Behavioral tests	Not reported
Cushing's syndrome						
Lin 1991 [21]	RCT, parallel 1	Induced Cushing's syndrome 8 dogs	A: EA at ST 36 30 minutes 3 times/week for 3 consecutive weeks	B: EA at nonacupuncture points	Cortisol level before and after ACTH	$P < .05$ in favor of A compared with B
Anesthesia						
Dill 1988 [19]	RCT, cross-over 1	Experimental halothane anesthesia 7 ponies	A: EA at GV 26 B: Moxibustion at GV 26 5 minutes throughout experiment	C: EA at nonacupuncture point D: Moxibustion at non-acupuncture point	Cardiac output, blood pressure, heart rate	No intergroup differences
Jeong 2002 [20]	RCT, cross-over 1	Experimental isoflurane anesthesia 8 dogs	A: EA at LI 4 B: EA at SP 6 C: EA at ST 36 D: EA at TH 8 30 minutes throughout experiment	E: No treatment F: EA at nonacupuncture point	Decrement of minimum alveolar concentration	$P < .05$ in favor of A or B or C or D compared with E or F
Clifford 1983 [11]	CCT, parallel 0	Experimental halothane anesthesia 22 dogs	A: Acupuncture by electrocautery at Go 26 10 minutes during experiment	B: No treatment C: DMSO	Cardiac output	Not reported $p < .05$ increase compared with baseline for A and C
Clifford 1977 [12]	CCT, parallel 0	Experimental halothane anesthesia 39 dogs	A: EA at ST 36 B: EA at ST 36 and atropine 30 minutes during experiment	C: No treatment D: Atropine	Cardiac output	Not reported $p < .05$ decrease compared with baseline for A Not reported $p < .05$ increase compared with baseline for B and D
Lee 1980 [14]	CCT, parallel 0	Experimental halothane anesthesia 35 dogs	A: Acupuncture at Go 26 10 minutes during experiment	B: No treatment C: Sodium salicylate D: Morphine sulphate	Cardiac output	Not reported $p < .05$ increase compared with baseline for A and C
Lee 1975 [15]	CCT, cross-over 0	Experimental halothane anesthesia 14 dogs	A: Acupuncture at ST 36 30 minutes during experiment	B: No treatment C: Acupuncture at nonacupoints	Cardiac output	Not reported; $p < .05$ decrease compared with baseline for A

Table 1. Continued

First author Year [reference]	Study Design Quality score	Condition N species	Intervention groups	Control groups	Main outcome measure	Intergroup difference for main outcome measure
Reproductive system						
Lin 1992 [34]	RCT, parallel 1	GnRH challenge 16 gilts	A: EA at Wei-Ken and Pai-Hui 2 h prior to GnRH B: EA at Wei-Ken and Pai-Hui 24 h prior to GnRH A and B for 30 minutes each	C: EA at Chiang-Feng and Chou-Shou 2 h prior to GnRH D: EA at Chiang-Feng and Chou-Shou 24 h prior to GnRH C and D for 30 minutes each	Luteinizing hormone response	$P < 0.05$ reduced effect in A compared with B or C or D
Toyota 1990 [35]	CCT, parallel 0	Reproductive disorders (over 50 days since last delivery) 206 cattle	A: EA at Hyakue, Koso and others B: EA and drug therapy	C: Drug therapy only	Percentage cure rate (appearance of estrus within 15 or 30 days)	Not reported In decreasing order in favor of A or B
		Healthy cattle over 50 days since last delivery 90 cattle	A: Moxibustion at Hyakue and Bikon Twice with an interval of 10 days	B: No treatment	Percentage cure rate (appearance of estrus within 20 days)	Not reported In decreasing order in favor of A
		Infertility (No conception after 3 AIs) 150 cattle	A: Moxibustion at Tempei, Hyakue, Kaifu, Bikon B: Moxibustion at Hyakue and Bikon C: Conventional treatment and B 4 consecutive days after fertilisation	D: No treatment	Percentage cure rate (Conception with one fertilization)	Not reported In decreasing order in favor of C or A or B
Diarrhea						
Hwang 1988 [13]	CCT, parallel 0	*E. coli*-induced diarrhea 34 pigs	A: EA at GV 1, Bai Hui and ST 36 B: Acupuncture at GV 1, ST 36 and BL 20 and moxibustion at CV 12 and ST 25 and hemoacupuncture 20 minutes for 4 consecutive days	C: Neomycin D: No treatment	Recovery rate at postinoculation day 3	$P < .005$ in favor of B and C compared with A and D
Lin 1988 [36]	CCT, parallel 0	Preweaning diarrhea 171 pigs	A: Acupuncture at VG 1 (saline injection) Once at one day of age	B: Acupuncture at neck point (saline injection)	Occurrence of diarrhea	No intergroup difference
		Preweaning diarrhea 269 pigs	A: Acupuncture at VG 1 (saline injection) Twice a day for 1-3 consecutive days after onset of diarrhea	B: Lactose	Duration of diarrhea	$P < .01$ in favor of A compared with B
Park 2003 [17]	CCT, parallel 0	*E. coli*-induced diarrhea 32 pigs	A: Acupuncture at GV 1 For 3 consecutive days	B: Enrofloxacin C: No treatment D: No inoculation, no treatment	Recovery time in days	Not reported
Watanabe 1998 [37]	CCT, parallel 1	Diarrhea 71 cattle	A: Conventional therapy and catgut burying at Koso	B: Conventional therapy	Percentage cure rate	Intergroup difference in favor of A compared with B

Table 1. Continued

First author Year [reference]	Study Design Quality score	Condition N species	Intervention groups	Control groups	Main outcome measure	Intergroup difference for main outcome measure
Hepatitis						
Lee 2004 [16]	CCT, parallel 0	Induced hepatitis 10 dogs	A: Auriculoacupuncture and acupuncture point massage at hepatic points 20 minutes once daily for 5 days	B: No treatment	Enzyme activities of ALT and AST	Intergroup difference in favor of A compared with B
Rumen Acidosis						
Mizuno 1984 [38]	CCT, parallel 1	Rumen acidosis 32 cattle	A: Acupuncture at Junki points and conventional therapy	B: Gastrolavage and operation depending on individual condition	Percentage cure rate	Intergroup difference in favor of A compared with B

RCT, randomized controlled trial; CCT, controlled clinical trial; EA = electroacupuncture; DMSO = dimethyl sulfoxide; AI = artificial insemination; LH = luteinizing hormone; ALT, alanine transaminase; AST, aspartate transaminase.
Quality score (maximum 5 points): 1 point if the outcome was assessed in a blind manner, 1 point if the owner was blind to avoid a transferred placebo effect on the animal, 1 point if reported as randomized and 1 point if the method of randomization was described and appropriate, 1 point for the description of dropouts and withdrawals.

results were achieved combining conventional therapy and electroacupuncture or moxibustion.

Diarrhea

The effectiveness of acupuncture for treating diarrhea was tested in CCTs in juvenile pigs suffering from *Escherichia coli*-induced or preweaning diarrhea.[13,17,36] There were no prophylactic effects of acupuncture given on the 1st day of life. Treatment effects, however, were suggested in favor of acupuncture at VG 1, compared with effects in controls.[36] Two other studies did not report separate statistical comparisons for acupuncture groups.[13,17] In another CCT, a group of calves that underwent permanent stimulation of acupuncture points by implantation of catgut in addition to conventional therapy, had significantly positive findings, compared with those for the group receiving standard care only.[37]

Hepatitis

The effect of auricular acupuncture for induced acute hepatic injury in dogs was assessed in a CCT.[16] The dogs were additionally treated with massage at the affected hepatic region. The main outcome measures, enzyme activities, indicated a significant intergroup difference in favor of the acupuncture group, compared with no treatment. Histopathologic findings after euthanasia indicated a decrease in area of the necrotic region and size of lipid droplets in the acupuncture group.

Rumen Acidosis

In cattle, rumen acidosis was treated comparing conventional therapy (gastrolavage and surgery, depending on the individual condition) with conventional therapy plus acupuncture.[38] A significant intergroup difference in the cure rate in favor of acupuncture was seen.

Discussion

On the basis of this systematic review, evidence for the effectiveness of acupuncture in domestic animals is weak and not sufficiently compelling to recommend or reject this treatment option for any condition. Encouraging evidence exists for alleviation of cutaneous pain and diarrhea, which warrants further investigation in rigorous trials. Single trials indicated some positive intergroup differences for spinal cord injury, Cushing's syndrome, lung function, hepatitis, and rumen acidosis. However, these trials require independent replication, preferably in large, blinded RCTs. When evaluating these data, it should, of course, be remembered that absence of evidence of effectiveness is not evidence of absence of effectiveness.

Although this systematic review used methodology that was developed by the Cochrane Collaboration in numerous research papers and books[39] and is well accepted in human medicine, it represents a less well accepted approach in veterinary medicine. There are, however, no good reasons for not adopting the methodology of a systematic review also in this area.

We included the data from RCTs and CCTs, and there were no restrictions regarding the language of publication. Nonrandomized trials tend to overestimate the size of the effect.[40] Therefore, such data should be viewed with caution and weighted accordingly. Formal assessment of methodologic quality by means of the score developed by Jadad et al[7] suggested generally low scores. Blinding and randomization were not adequately described in many studies. There are, of course, many other scoring systems used for methodologic quality, most of which are more elaborate. However, the Jadad score is an accepted, frequently used, and easy to apply score. Jüni et al have documented that there are no strong advantages of these instruments over the Jadad score.[41] We, therefore, opted to use what is widely used and validated. The score was not used as an inclusion/exclusion criterion and provided only additional information on methodologic quality.

The identified evidence relates to a large number of different conditions, acupuncture techniques, and outcome measures. In cases where encouraging evidence exists, frequently independent replication is not available. Thus, at present, there is no coherent body of evidence for any condition. For future research, a stronger focus on relevant questions is needed. This would enable meta-analyses of data within systematic reviews and generate more precise effect estimates.

Other limitations of the evidence reviewed here relate to the small sample size and the lack of intergroup comparisons. The control treatments covered a wide range of methods and, in most instances, the control intervention was needling at nonacupuncture points. Other interventions for controlling nonspecific effects such as nonpenetrating placebo devices or nonapplication of electrical currents in trials of electroacupuncture often were not considered. This raises doubts about the appropriateness of the sham interventions used and their effects on the outcome measures.

In addition to naturally acquired clinical conditions, we decided to include experimentally induced conditions and clearly label them as such, so that the reader can reproduce and verify our results and conclusions. Overall, 18 such trials were retrieved. Because of the clinical heterogeneity and the scarcity of trials on similar research questions, we did not perform statistical data synthesis. Therefore, we weighed the trials separately, each on their own merit. Rather than having a distorting effect, the inclusion of trials on experimentally induced conditions widened the scope of this review. Studies in mice, rats, rabbits, gerbils, hamsters, and guinea pigs were not within the scope of this systematic review.

We aimed to identify all RCTs and CCTs of acupuncture in veterinary medicine. The potential incompleteness of the citation tracking is one of the limitations that apply to systematic reviews in general. Although great effort was made to retrieve all relevant data, it is conceivable that some studies were not found. The distorting effects on systematic reviews from publication bias and location bias are well documented.[42–48] It is, for instance, problematic to restrict literature searches to 1 language or database. For this project, we, therefore, searched databases with a focus on American, Asian, and European literature and those that specialize in CAM. There were no restrictions in terms of publication language. The appraisal of the evidence involved a degree of judgment in some instances. However, we used a modified standard scale[7] to assess important criteria of methodologic quality, and the process of appraising the clinical evidence was performed independently by at least 2 reviewers.

Future studies in this area should aim at overcoming the present shortcomings in the literature. In particular, they should apply accepted diagnostic criteria, include adequate sample sizes, use high-quality acupuncture (eg, on the basis of a consensus of experts) for an adequate treatment duration, use validated, clinically meaningful, outcome measures and use adequate statistical methods. Such studies are likely to be expensive, and adequate funding of research in this area should be secured.

In conclusion, on the basis of the findings of this systematic review, there is no compelling evidence to recommend or reject acupuncture for any condition in domestic animals. Some encouraging data do exist, and warrant further investigation in independent rigorous trials.

Acknowledgment

We thank Hitoshi Yamashita, PhD, Tsukuba College of Technology Clinic, Tsukuba, Japan, for his help in identifying and extracting data from Japanese language studies.

References

1. Barnes PM, Powell-Griner E, McFann K, Nahin RL. Complementary and alternative medicine use among adults: United States, 2002. Adv Data 2004;343:1–19.

2. Tindle HA, Davis RB, Phillips RS, Eisenberg DM. Trends in use of complementary and alternative medicine by US adults: 1997–2002. Altern Ther Health Med 2005;11:42–49.

3. Scott S. Developments in veterinary acupuncture. Acupunct Med 2001;19:27–31.

4. Filshie J, White AR. Medical acupuncture. Edinburgh, PA: Churchill Livingstone; 1998:225–294.

5. Linde K, Vickers A, Hondras M, et al. Systematic reviews of complementary therapies—An annotated bibliography. Part I: Acupuncture. BMC Complementary and Alternative Medicine 2001:Issue 1 (on line) http://www.biomedcentral.com/1472-6882/1/3 (accessed 20 September 2004).

6. Zhao CH, Stillman MJ, Rozen TD. Traditional and evidence-based acupuncture in headache management: Theory, mechanism, and practice. Headache 2005;45:716–730.

7. Jadad AR, Moore RA, Carroll D, et al. Assessing the quality of randomized clinical trials: Is blinding necessary? Controlled Clin Trials 1996;17:1–12.

8. Bossut DF, Leshin LS, Stromberg MW, et al. Plasma cortisol and beta-endorphin in horses subjected to electroacupuncture for cutaneous analgesia. Peptides 1983;4:501–507.

9. Bossut DF, Page EH, Stromberg MW. Production of cutaneous analgesia by electroacupuncture in horses: Variations dependent on sex of subject and locus of stimulation. Am J Vet Res 1983;45:620–625.

10. Bossut DF, Stromberg MW, Malven PV. Electroacupuncture-induced analgesia in sheep: Measurement of cutaneous pain thresholds and plasma concentrations of prolactin and beta-endorphin immunoreactivity. Am J Vet Res 1986;47:669–676.

11. Clifford DH, Lee DC, Lee MO. Effects of dimethyl sulfoxide and acupuncture on the cardiovascular system of dogs. Ann N Y Acad Sci 1983;411:84–93.

12. Clifford DH, Lee MO, Lee DC. Cardiovascular effects of atropine on acupuncture, needling with electrostimulation, at Tsu San Li (St-36) in dogs. Am J Vet Res 1977;38:845–849.

13. Hwang YC, Jenkins EM. Effect of acupuncture on young pigs with induced enteropathogenic *Escherichia coli* diarrhea. Am J Vet Res 1988;49:1641–1643.

14. Lee DC, Lee MO, Clifford DH. Comparison of sodium salicylate, morphine sulfate and acupuncture at Jen-Chung (Go 26) on the cardiovascular system of dogs. Am J Chin Med 1980;8: 245–253.

15. Lee MO, Lee DC, Kim S, et al. Cardiovascular effects of acupuncture at Tsu San Li (ST-36) in dogs. J Surg Res 1975;18: 51–63.

16. Lee S, Song K, Liu J, et al. The effectiveness of auriculoacupoint treatment for artificially induced acute hepatic injury in dogs. Am J Chin Med 2004;32:445–451.

17. Park E, Seong J, Nam T, et al. Effect of acupuncture in the treatment of young pigs with induced *Escherichia coli* diarrhea. J Vet Sci 2003;4:125–128.

18. Yang J, Jeong S, Seo K, et al. Effects of corticosteroid and electroacupuncture on experimental spinal cord injury in dogs. J Vet Sci 2003;4:97–101.

19. Dill SG, Gleed R, Matthews NS, et al. Cardiovascular effects of acupuncture stimulation at point Governing Vessel 26 in halothane-anesthetized ponies. Am J Vet Res 1988;49:1708–1712.

20. Jeong SM. Effects of electroacupuncture on minimum alveolar concentration of isoflurane and cardiovascular system in isoflurane anesthetized dogs. J Vet Sci 2002;3:193–201.

21. Lin JH, Su HL, Chang SH, et al. Treatment of iatrogenic Cushing's syndrome in dogs with electroacupuncture stimulation of Stomach 36. Am J Chin Med 1991;19:9–15.

22. Merritt AM, Xie H, Lester GD, et al. Evaluation of a method to experimentally induce colic in horses and the effects of acupuncture applied at the Guan-yuan-shu (similar to BL-21) acupoint. Am J Vet Res 2002;63:1006–1011.

23. Skarda RT, Muir WW. Comparison of electroacupuncture and butorphanol on respiratory and cardiovascular effects and rectal pain threshold after controlled rectal distention in mares. Am J Vet Res 2003;64:137–144.

24. Skarda RT, Tejwani GA, Muir WW. Cutaneous analgesia, hemodynamic and respiratory effects, and beta-endorphin concentration in spinal fluid and plasma of horses after acupuncture and electroacupuncture. Am J Vet Res 2002;63:1435–1442.

25. Wright M, McGrath CJ. Physiologic and analgesic effects of acupuncture in the dog. J Am Vet Med Assoc 1981;178: 502–507.

26. Steiss JE, White NA, Bowen JM. Electroacupuncture in the treatment of chronic lameness in horses and ponies: A controlled clinical trial. Can J Vet Res 1989;53:239–243.

27. Sumano H, Bermudez E, Obregon K. Treatment of wobbler syndrome in dogs with electroacupuncture. Dtsch Tierärztl Wochenschr 2000;107:231–235.

28. Bolliger C, DeCamp CE, Stajich M, et al. Gait analysis of dogs with hip dysplasia treated with gold bead implantation acupuncture. Vet Comp Orthop Traumatol 2002;2: 116–122.

29. Hielm-Bjorkman A, Raekallio M, Kuusela E, et al. Double blind evaluation of implants of gold wire at acupuncture points in the dog as a treatment for osteoarthritis induced by hip dysplasia. Vet Rec 2001;149:452–456.

30. Klide AM, Martin BB. Methods of stimulating acupuncture points for treatment of chronic back pain in horses. J Am Vet Med Assoc 1989;195:1375–1379.

31. Still J, Davies N, Matzner L, et al. A comparison of anaesthetic and postanaesthetic effects of placebo, buprenorphine and auricular electroacupuncture in bitches ovariohysterectomised under halothane anaesthesia. Int J Alt Comp Med 1998;4:26–33.

32. Kim DH, Cho SH, Song KH, et al. Electroacupuncture analgesia for surgery in cattle. Am J Chin Med 2004;32:131–140.

33. Hwang YC, Held JP. A preliminary report on an attempt to modify behavior of untamed ponies by acupuncture. Am J Chin Med 1981;9:84–92.

34. Lin JH, Wu LS, Dzang SH, et al. Pituitary responsiveness to gonadotrophin-releasing hormone in gilts treated with electroacupuncture, 18th International Veterinary Acupuncture Society (IVAS) Congress, September 1992, Maui, HI, 1992:43–46.

35. Toyota T. Jutai-ritsu kojo no tame no toyo ju-igaku no kento. Kachiku Jinko Jusei 1990;138:44–46.

36. Lin JH, Lo YY, Shu NS, et al. Control of preweaning diarrhea in piglets by acupuncture and Chinese medicine. Am J Chin Med 1988;16:75–80.

37. Watanabe K, Mizuno S, Suzuki K, et al. Effect of the catgut burying therapy in an acu-point for diarrhea of Japanese black calf. J Vet Clin 1998;45:27–31.

38. Mizuno S, Tada H. Toshoku ni yoru Rumenacidosis ni taisuru Junki-shin ryoho (kasho) no koka ni tsuite. J Vet Clin 1984; 247:15–18.

39. Egger M, Davey Smith G, Altman DG. Systematic Reviews in Health Care: Meta-Analysis in Context, 2nd ed. London: BMJ Publishing Group, 2001.

40. Schulz KF, Chalmers I, Hayes RJ, Altman DG. Empirical evidence of bias. Dimensions of methodological quality associated with estimates of treatment effects in controlled trials. JAMA 1995; 273:408–412.

41. Jüni P, Witschi A, Bloch R, Egger M. The hazards of scoring the quality of clinical trials for meta-analysis. JAMA 1999;282:1054–1060.

42. Dickersin K. The existence of publication bias and risk factors for its occurrence. JAMA 1990;263:1385–1389.

43. Easterbrook PJ, Berlin JA, Gopalan R, et al. Publication bias in clinical research. Lancet 1991;337:867–872.

44. Egger M, Davey Smith G. Bias in location and selection of studies. BMJ 1998;316:61–66.

45. Ernst E, Pittler MH. Alternative therapy bias Nature 1997;385:480.

46. Pittler MH, Abbot NC, Harkness EF, et al. Location bias in controlled clinical trials of complementary/alternative therapies. J Clin Epidemiol 2000;53:485–489.

47. Schmidt K, Pittler MH, Ernst E. Bias in alternative medicine is still rife but is diminishing. BMJ 2001;323: 1071.

48. Vickers A, Goyal N, Harland R, et al. Do certain countries produce only positive results? A systematic review of controlled trials. Control Clin Trials 1998;19:159–166.