

TCVM for Avian, Laboratory and Exotic Species

Evaluation of Electro-Acupuncture for Management of Sedative-Associated Gastrointestinal Motility Changes in Rabbits (*Oryctolagus cuniculus*): A Pilot Study

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ABSTRACT

Electro-acupuncture (EAP) has been proposed as a potential intervention for decreased gastrointestinal (GI) motility in domestic rabbits (*Oryctolagus cuniculus*); however, prospective studies evaluating this approach in clinical settings are lacking. Twelve juvenile New Zealand White rabbits (6 male, 6 female) underwent two sedation events in a complete crossover study conducted during 2 veterinary teaching laboratories 4 weeks apart. Following recovery from sedation, rabbits received one of two treatments: EAP or control (no acupuncture). Total pre- and post-treatment pellet consumption and fecal output were measured and compared between study groups. Gastrointestinal performance was evaluated at 24 hours post-sedation using cumulative pellet consumption, cumulative fecal output, and the difference between cumulative pellet consumption and fecal output. Apparent digestibility was also calculated and compared between groups and stratified by food intake, defined as heavy consumption (>181 g) or light consumption (<181 g). Electro-acupuncture treatment did not significantly alter cumulative pellet consumption or cumulative fecal output compared with controls. Apparent digestibility values, however, demonstrated significantly lower digestibility in rabbits consuming larger amounts of food compared with those consuming less ($p=0.048$). The lower values reflect that a greater proportion of consumed food was recovered as fecal material and may suggest accelerated GI transit in the acupuncture group (heavy food consumption rabbits). Although electro-acupuncture demonstrated some potential to influence GI motility in this pilot study, additional better controlled studies with larger sample sizes are needed to support the validity of findings from this study and to further evaluate clinical relevance.

Keywords: acupuncture, electro-acupuncture, gastrointestinal stasis, GI motility, *Oryctolagus cuniculus*, rabbit

ABBREVIATIONS: EAP: electro-acupuncture; GI: gastrointestinal

Acupuncture is widely used in veterinary medicine for the clinical management of a variety of conditions in domestic species. Its application has been particularly well described in equine medicine where specific acupoint recommendations exist for management of cervical stiffness, back pain, laminitis, laryngeal hemiplegia, neuropathy, and colic.¹⁻⁴ Interest in applying traditional Chinese medicine approaches and transposition of acupoints to companion exotic species, such as the domestic rabbit (*Oryctolagus cuniculus*), are scant in the literature but growing.^{5,6} Horses and rabbits share similarities in gastrointestinal physiology, specifically both species implement hind-gut fermentation, that may make rabbits potential candidates for an acupuncture-based approach targeting GI motility similar to horses. Gastrointestinal differences in the 2 species, however, do exist. For example, rabbits exhibit cecotrophy, a process absent in horses, which can increase colonic

motility by 1.5-2 times the normal rate and shorten overall GI transit time. Despite some differences, both species are susceptible to clinically significant and potentially life-threatening motility issues.^{7,8} In horses, studies have investigated acupuncture for the management of GI ileus and other digestive disorders with mixed results, whereas comparable rabbit-specific studies remain scarce.^{3,4,9-11}

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Gastrointestinal stasis is one of the most common clinical afflictions observed in domestic rabbits. This describes reduced or absent GI motility, and it can have serious sequelae. It is merely a clinical sign of an underlying issue – either stress, gastrointestinal disease, or non-gastrointestinal disease.¹² Even if the underlying issue is corrected, animals can still succumb to the consequences, specifically due to changes in cecal microflora that lead to *Clostridium* and coliform overgrowth, enterotoxemia, and death.¹² Consumption of fiber is the primary driver of cecocolic motility in rabbits, and for that reason the sooner a rabbit begins consuming fiber, the faster and more likely a clinician is able to eliminate gastrointestinal stasis and its sequelae.¹² Some animals, however, are anorexic and other methods of managing stasis are needed. One method of particular interest is the use of electro-acupuncture (EAP) which has been shown to be able to normalize gastric electrical activity and has regulatory effects on GI motility.^{10,11} The level of gastrointestinal motility is inverse to digestibility, and may vary based on level of food intake as has been recently reported in rabbits.¹³

The goal of this study was to identify whether EAP increases gastrointestinal motility following sedation of rabbits. It was hypothesized that rabbits receiving EAP after sedation with ketamine and dexmedetomidine followed by reversal with atipamezole would have altered GI motility with respect to food consumption and fecal production compared to rabbits not receiving EAP under the same sedation and reversal protocol.

MATERIALS AND METHODS

Animals

Twelve (6 female, 6 male) 3–5-month-old New Zealand White rabbits^a arrived one week prior to the initiation of the study and underwent physical examination by a veterinarian. All were deemed healthy. Females weighed 2.68 ± 0.07 kg (mean $\pm$ SD) while males weighed 2.17 ± 0.06 kg. Animals were housed individually in enclosure banks^b (26" long $\times$ 26" wide $\times$ 18" tall) in a temperature and humidity-controlled environment (temperature 61–72°F; humidity 30–70%) with 12-hour light and 12-hour dark cycle. Rabbits received ad libitum tap water and formulated rabbit pellets^c. Rabbits also received a wide variety of enrichment items including balls, rattles, and blocks among others.

Study Design

The study design was approved by North Carolina State University College of Veterinary Medicine IACUC #23-216. All 12 rabbits were sedated on two separate dates four weeks apart. These sedation events were part of the Doctor of Veterinary Medicine (DVM) curriculum on rabbit clinical techniques and were performed in a classroom laboratory setting. Sedatives for all rabbits included ketamine^d (17.5 mg/kg) and dexmedetomidine^e (0.025 mg/kg) combined and administered intramuscularly

in epaxial muscles. For the laboratory, DVM students administered the initial sedatives, performed physical exams, attempted venipuncture (maximum of two attempts per site; sites included cephalic and saphenous veins as well as auricular arteries), and practiced subcutaneous, intramuscular, and intravenous injections prior to reversal. At the end of all laboratory activities, atipamezole^f (0.25 mg/kg) reversal was administered intramuscularly by a single veterinarian (LM). Sedation and reversal protocol was elected based on research that identified ketamine administered with an alpha-2 agonist significantly increased GI transit time in New Zealand White rabbits and reversal with an alpha-2 antagonist, specifically atipamezole, did not antagonize the gastrointestinal effects of the alpha-2 agonist.¹⁴ On recovery, animals were randomly sorted using an online randomizer^g into Treatment Group (EAP) versus Control Group (no EAP). During the second laboratory, animals underwent the opposite treatment in a complete crossover design. Food pellet consumption and fecal output in weight (grams) were measured at the following intervals for both trials: approximately 24 hr prior to laboratory (7:00 AM to 7:00 AM day prior to laboratory), 0 hr (start time in all trials 1:00–3:00 PM, this value was always 0), 1 hr, 2 hr, 3 hr, 6 hr, 12 hr, and 24 hr post-laboratory. The 0 hr timepoint was started immediately after rabbits were returned to their enclosure following completion of the student laboratory and receiving either treatment (EAP versus control). In so doing, rabbits had continuous access to ad libitum tap water and rabbit pellets^c for the 24-hours immediately following treatment. Timepoint measures after control or treatment are cumulative. For example, the 24-hr post-laboratory timepoint is the total amount of pellets consumed or feces produced since timepoint 0 hr. Body weight (grams) was obtained at the following intervals: approximately 48 hr prior to laboratory (7:00 AM), 24 hr prior to laboratory (7:00 AM), 0 hr (1:00–3:00 PM), and 24 hr post-laboratory (1:00–3:00 PM). Cecotrophy was not monitored.

Electro-acupuncture

Immediately after reversal administration, an electro-acupuncture stimulator^h was used at intensity 3, 20 Hz (F1=2, $\times 10$; F2=0) with continuous wave form, and the following points were stimulated for 10 minutes via cables connected to 32-gauge acupuncture needlesⁱ (32# $\times$ 1" 0.25 $\times$ 25 mm), at an estimated depth of 3–5 mm: left BL-21 to BL-25; left ST-36 to ST-37; right BL-21 to BL-25; right ST-36 to ST-37. The following points were stimulated via dry-needle technique with the same 32-gauge acupuncture needle as used with the EAP points: LI-10, LI-11, ST-40, GV-1, *Bai-hui*, GV-20 and *Shan-gen* (Figure 1, Table 1). Note that acupoints were stimulated bilaterally if applicable. Intensity refers to the strength of the electrical current delivered via the needles while “F” is in reference to frequency of the electrical pulse, measured in Hz. This protocol was based on author experience and protocol described in Harrison et al.⁵

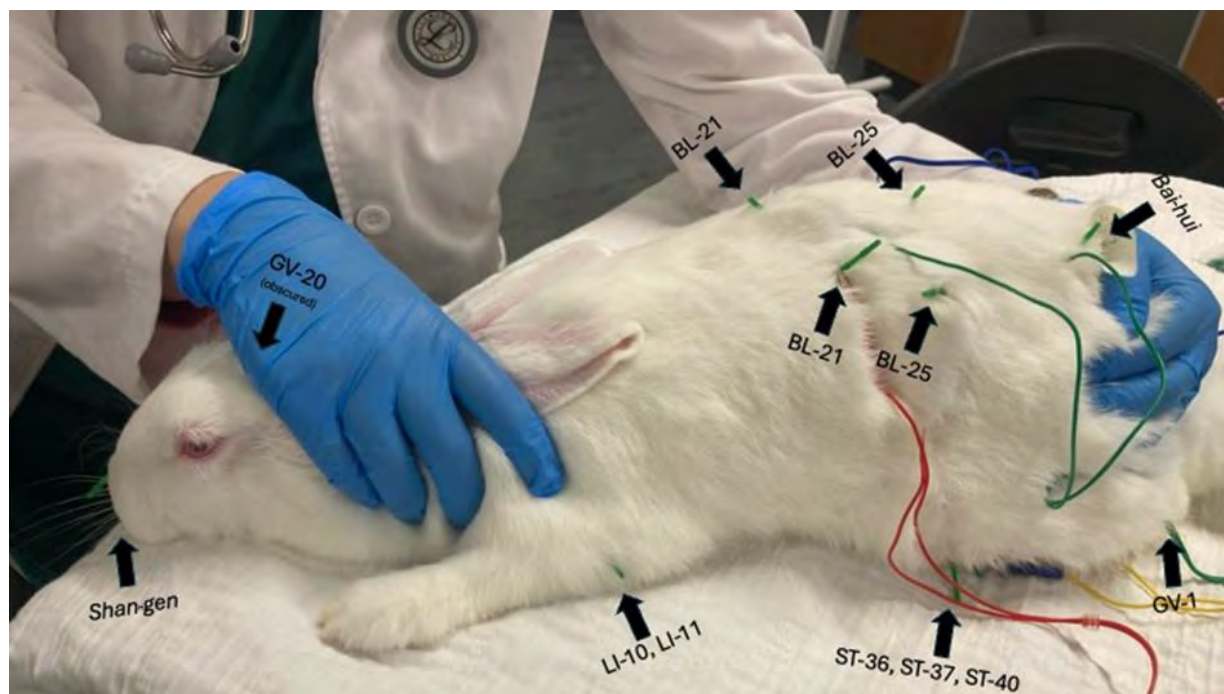


Figure 1: New Zealand White rabbit (*Oryctolagus cuniculus*) undergoing electro- or dry needle acupuncture for 10 minutes at the following points: GV-20 (dorsal midline of skull), *Shan-gen* (bridge of nose where haired and non-haired skin meet), LI-10 (lateral antebrachium), LI-11 (lateral cubital joint), ST-36 (distal to stifle, within tibial musculature), ST-37 (distal to stifle, lateral to anterior crest of the tibia), ST-40 (lateral midshaft region of the tibia), GV-1 (perineum, between anus and scrotum or vulva), *Bai-hui* (caudo-dorsal midline), BL-21 (lateral to spine, at the caudal level of the last thoracic vertebra), and BL-25 (lateral to spine, at the caudal level of the 5th lumbar vertebra).

Table 1: Acupuncture points utilized in New Zealand White rabbit (*Oryctolagus cuniculus*) and their associated locations and clinical indications

Point	Indications	Location
<i>Shan-gen</i>	Appetite stimulant	Bridge of nose midline at distal portion of actual nose, where haired and non-haired skin would meet
GV-20	Calming point	Dorsal midline of skull, at highest portion of the skull at midpoint of the ears then connect that area to the mid-point of the skull
LI-10	Immune regulation, general tonic, diarrhea	Lateral radius and is located 2 <i>cun</i> distal to LI-11, it is between extensor carpi radialis and common digital extensor muscles in a slight indentation between the muscle
LI-11	Diarrhea, constipation	Dorsal/lateral humerus, at the lateral end of cubital crease
ST-36	Master point for gastrointestinal tract and abdomen, nausea, vomiting, gastric pain, gastric ulcer, food stasis, general tonic	Just caudal/lateral to the distal edge of the tibial crest within the muscle next to the tibial crest
ST-37	Diarrhea, intestinal ulcers, constipation	3 <i>cun</i> distal to ST-36, and 0.5 <i>cun</i> lateral to the cranial aspect of the tibia
ST-40	Connecting point to Spleen	Midpoint of the tibia and 2 <i>cun</i> lateral from midline
GV-1	Diarrhea, constipation, perianal problems, epilepsy	Perineum, midline between anus and the base of the tail
<i>Bai-hui</i>	Calming point	Caudo-dorsal midline at the lumbo-sacral junction
BL-21	Stomach, abdominal pain, constipation, vomiting, gastric ulcer, diarrhea, abdominal fullness	1.5 <i>cun</i> lateral to spine, at the caudal level of the last thoracic vertebra
BL-25	Large intestine, abdominal pain, diarrhea, constipation, back pain	1.5 <i>cun</i> lateral to spine, at the caudal level of the 5 th lumbar vertebrae

Statistics

All analyses were performed with IBM SPSS Statistics^j and R Statistics^k. Comparisons of cumulative food consumption and fecal production at 24 hours post-sedation between the EAP and control groups were conducted using the paired *t*-test within the crossover design, where each rabbit served as its own control.

Statistical analyses were performed using raw gram values rather than body weight-normalized values because body weight was strongly correlated with food consumption ($r=0.85$), and normalization could therefore obscure biologically relevant intake differences. Descriptive data in Tables 2 and 3 are presented as g/kg body weight to facilitate comparison across rabbits of different sizes.

Apparent digestibility was calculated as the cumulative amount of food eaten after time zero (completion of sedation and potential EAP) until time 24 hours minus the cumulative amount of fecal material produced during the same time period, with results reported in grams. Because substantial variability was observed in voluntary food intake following sedation, an additional exploratory analysis was performed to determine whether the relationship between EAP and gastrointestinal function differed according to food intake level. This stratification was performed because apparent digestibility and fecal production are influenced by the quantity of ingesta present within the GI tract, and potential effects of EAP on gastrointestinal transit may be more detectable in rabbits consuming larger quantities of food. The rabbits were therefore stratified into lower (< 181 g) and higher (> 181 g) food consumption groups (50% food consumption=181 g); based on 24-hour pre-treatment food intake (immediately prior to acupuncture). Because this was a crossover study, 24-hour pre-treatment food consumption was recorded separately before each laboratory session; therefore, each rabbit contributed two pre-treatment intake observations across the study. Intake category was assigned at the treatment-period level rather than by rabbit identity, such

that an individual rabbit could be classified differently between treatment periods if pre-treatment intake varied between sessions. Additionally, for two rabbits consuming food at a level of 181 g, one rabbit was randomly assigned to the lower food consumption category, and the other rabbit assigned to the higher food consumption category.

A two-way mixed-effects ANOVA was conducted with digestibility as the dependent variable, treatment group (EAP versus control) and food-consumption category (lower versus higher food consumption) as fixed effects, and rabbit identity as a random effect to account for repeated measurements within the crossover design. In addition to the 50% to 50% comparison of lower versus higher food consumption levels, additional partition-based subset comparisons ranging from 25% lower to 75% higher intake through 75% lower to 25% higher were also explored to evaluate the consistency of statistical significance across intake thresholds. Association of body weight with food consumption during the 24-hour pre-treatment period, immediately prior to acupuncture, was evaluated through Pearson product-moment correlation. The Shapiro-Wilk normality test was used to verify that data followed a normal distribution. Significance was classified as p -value <0.05.

Table 2: Amount of pelleted diet per body weight consumed by New Zealand White rabbits (*Oryctolagus cuniculus*) in g/kg over the course of a study evaluating electro-acupuncture for gastrointestinal motility. The -24-hour point represents food consumption of rabbits from -48 hours to -24 hours prior to sedation. The 0-hour point represents the food consumption of rabbits from -24 hours to 0 hours prior to sedation.

Pellets Consumed (g/kg)			
Hour	Treatment	Mean	SD
-24	Control	72.1	6.5
	Electro-acupuncture	70.9	10.8
0	Control	65.9	6.6
	Electro-acupuncture	60.7	7.1
1	Control	0.0	0.0
	Electro-acupuncture	0.0	0.0
2	Control	0.0	0.0
	Electro-acupuncture	0.2	0.8
3	Control	0.6	1.2
	Electro-acupuncture	1.6	2.1
6	Control	8.2	2.8
	Electro-acupuncture	7.0	3.6
12	Control	17.8	4.9
	Electro-acupuncture	16.6	6.2
24	Control	23.6	6.8
	Electro-acupuncture	24.6	5.8
Cumulative	Control	50.2	9.0
	Electro-acupuncture	50.0	8.6

Table 3: Amount of fecal output per body weight by New Zealand White rabbits (*Oryctolagus cuniculus*) in g/kg over the course of a study evaluating electro-acupuncture for gastrointestinal motility. Note that the 0-hour time point consisted of 11 rather than 12 individuals due to fecal material being soaked with urine and invalidating the weight for one rabbit in the Control Group. The -24-hour point represents the fecal output of rabbits from -48 hours to -24 hours prior to sedation. The 0-hour point represents the fecal output of rabbits from -24 hours to 0 hours prior to sedation.

Fecal Output (g/kg)			
Hour	Treatment	Mean	SD
-24	Control	48.6	11.6
	Electro-acupuncture	47.5	14.8
0	Control	57.2	11.6
	Electro-acupuncture	47.1	14.5
1	Control	0.5	0.9
	Electro-acupuncture	0.8	1.9
2	Control	0.7	1.2
	Electro-acupuncture	0.8	1.6
3	Control	1.0	1.3
	Electro-acupuncture	0.6	0.9
6	Control	4.4	5.7
	Electro-acupuncture	4.6	4.5
12	Control	16.8	9.5
	Electro-acupuncture	14.1	8.2
24	Control	12.0	10.1
	Electro-acupuncture	13.2	8.4
Cumulative	Control	35.4	13.8
	Electro-acupuncture	34.1	12.7

RESULTS

All rabbits underwent sedation, recovery, and electroacupuncture with no adverse effects noted. Rabbits were sedated for 42.2 ± 9.7 (mean $\pm$ SD) minutes on average, and sedation level permitted completion of the laboratory by DVM students as well as EAP by investigators in all individuals. One individual required a repeat half dose of ketamine to complete the laboratory and achieve sedation; this rabbit was excluded from sedation time average.

Food pellet consumption and fecal production during the 24-hour post-sedation period were compared between EAP and control treatments using paired analyses within the crossover design. During the earliest post-treatment timepoints (0-3 hr), intake was minimal in both groups, with slightly higher food consumption observed in the EAP group (absolute quantities small, standard deviations large relative to means). At 24 hr, food intake was nearly identical between groups, with cumulative means of 50.0 and 50.2 g/kg, for EAP and controls respectively (Table 2). Fecal production followed a similar pattern with marked reductions during the early post-treatment timepoints (1-2 hr) for both groups, with slightly higher values observed in the EAP group. Thereafter, fecal output gradually increased, with groups variably demonstrating higher values through the 24-hour post-treatment timepoints (Table 3).

Overall, both food pellet consumption and fecal output were greater during the 24-hr period prior to sedation than during the 24-hr period following sedation. The -24-hour values shown in Tables 2 and 3 represent cumulative food consumption and fecal output during the interval from 48 to 24 hours prior to sedation. The 0-hour values represent cumulative food consumption and fecal output during the 24-hour interval immediately preceding sedation and treatment. Data presented in Tables 2 and 3 include pooled observations from both crossover treatment periods. Across all evaluation timepoints, EAP treatment did not significantly alter either food pellet consumption or fecal output ($p > 0.05$).

Apparent digestibility differed according to intake level, with rabbits consuming larger quantities of food demonstrating significantly lower digestibility than those

consuming less ($p = 0.048$; Figure 2). Lower digestibility values are consistent with a greater proportion of consumed food recovered as fecal material, indicating potential alterations in GI motility. Because intake categorization was assigned separately for each treatment period, individual rabbits could contribute observations to different intake categories across the crossover study depending on pre-treatment food consumption during a given period.

Rabbits were stratified into lower versus higher levels of food consumption using a threshold of 181 g/day during the 24-hour pre-treatment period. Mean pre-treatment food consumption was 143.3 g/day in the lower-intake group and 208.6 g/day in the higher-intake group. Equal numbers of males and females were present in both groups. Rabbits in the higher-intake group had a significantly greater body weight than rabbits in the lower level of food consumption ($p < 0.001$), and pre-treatment intake category remained strongly associated with post-sedation food consumption levels ($p < 0.001$). Food pellet consumption and fecal output during the 24-hour post-sedation period did not differ significantly between EAP and control ($p > 0.05$). In both groups, food consumption and fecal output during the 24-hour post-sedation period were lower than during the corresponding 24-hour pre-sedation period.

Beyond the initial partitioning of those 50% of rabbits eating higher amounts of food compared to the other 50% of rabbits (i.e. 181 g threshold), additional intake thresholds were evaluated to determine whether the relationship between intake level and apparent digestibility was consistent across different intake stratifications. Additional food consumption thresholds were explored to determine whether the relationship between intake level and apparent digestibility remained consistent across some alternative stratification schemes. Significant differences were identified for the 33.3:66.7%, 37.5:62.5%, 41.7:58.3%, and 45.8:54.2% lower- versus higher-intake partitions. A significant difference was not found for apparent digestibility between female and male rabbits or for food pellet consumption between female and male rabbits pre- or post-EAP treatment ($p > 0.05$), although female rabbits had significantly greater body weight than male rabbits at the time of EAP treatment ($p = 0.003$).

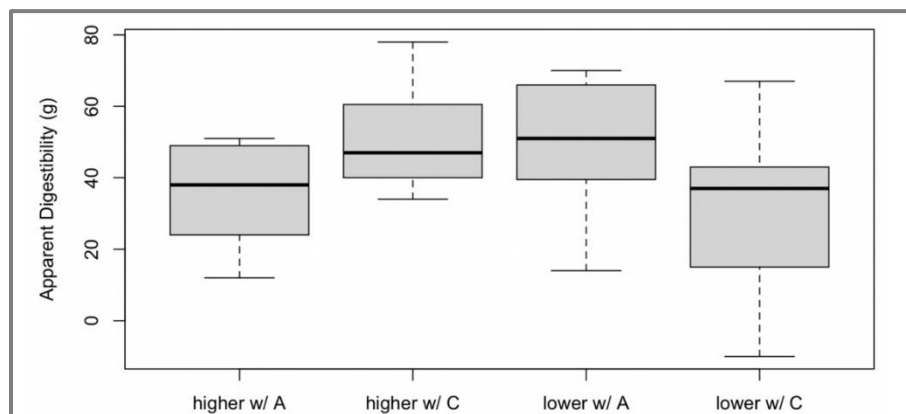


Figure 2: Distribution of apparent digestibility values across treatment and feeding categories. Calculated as: *apparent digestibility (g) = food consumed – fecal output*. Groups were stratified by treatment (acupuncture [w/ A] vs control [w/ C]) and by food consumption level: a lower level of eating (<181 g) and higher level of eating (>181 g). Box plots display the median (bolded central line), interquartile range, and overall distribution of values (whiskers) within each group. Lower apparent digestibility values reflect a greater proportion of consumed food recovered as fecal output.

DISCUSSION

This study evaluated whether EAP could improve gastrointestinal motility following sedation in domestic rabbits. In a crossover design involving 12 juvenile rabbits, pellet consumption, fecal output, and apparent digestibility were compared between EAP treatment and controls after recovery from sedation. Electro-acupuncture did not significantly affect cumulative pellet consumption or fecal output compared with control rabbits. Apparent digestibility, defined as the proportion of consumed food absorbed rather than excreted as fecal material, differed according to treatment group and food intake. Rabbits consuming larger amounts of food and treated with EAP demonstrated significantly lower digestibility ($p=0.048$). Given that fecal production after sedation is influenced by both food intake and recovery of GI motility, this finding may indicate that EAP altered GI transit in rabbits with sufficient ingesta available for processing.

Acupoints recommended for use in gastrointestinal stasis in rabbits have been published by Koh et al, with the majority of acupoints identified used in the present investigation.⁶ Extensive research has shown that acupuncture, particularly EAP, can influence GI motility and intestinal transit through modulation of autonomic and enteric neural pathways.^{15,16} Although rabbit-specific studies remain limited, available evidence suggests similar effects consistent with the broader body of research in other animal models and humans.^{10,11,17,18} For example, Niu et al. demonstrated that EAP at ST-36 in rabbits increases gastric myoelectrical spike activity and enhances gastrointestinal contractions, indicating improved motility and transit.¹⁰ Proposed mechanisms included modulation of cholinergic neural pathways, reduced nitric oxide synthase activity, and alterations in gastrointestinal hormones such as motilin and cholecystokinin. Additional rabbit studies report improved motility patterns following acupuncture at ST-36 and PC-6 in models of experimentally induced dysrhythmia and morphine-associated inhibition of duodenal peristalsis.^{11,17}

In the present study, the finding of lower apparent digestibility in EAP-treated rabbits is of interest due to the relationship of digestibility calculations being influenced by intestinal transit time. Accelerated motility shortens the time available for nutrient absorption, thereby lowering digestibility values. Given the importance of GI transit and hindgut fermentation in rabbit digestion, the reduced digestibility observed in rabbits receiving EAP and consuming larger quantities of food may reflect accelerated motility.^{7,12}

Interpretation of the validity of the present study's findings, however, requires consideration of several limiting factors. First, the findings of this study represent a pilot investigation into the use of EAP for management of GI motility in domestic rabbits. The study was conducted opportunistically using a limited number of animals within a student laboratory setting. Laboratory procedures themselves may have induced stress, which could potentially alter GI transit time. Additionally, students participating in the laboratory had variable levels

of experience and clinical skill with rabbits, potentially introducing additional stress-related variability. A second significant limitation included not monitoring cecotrophy, as this also alters GI motility. Resources were not available to perform this level of monitoring, but it is clearly recommended for future studies. Similarly, due to resource limitation, rabbits were only monitored through 24 hours post-treatment, but a longer monitoring period to no less than 48 hours is recommended for further research. Additionally, circadian rhythm can impact food consumption in rabbits.¹⁹ Due to resource limitations and laboratory timing outside the control of this opportunistic study, this is a potentially confounding variable that could not be accounted for in study design. Student laboratories, however, were all performed at similar times in the early afternoon for both trial phases and this likely helped control limitations associated with this issue. Finally, to more fully assess the impact of these laboratory procedures on GI function and whether EAP promotes recovery of GI motility, as suggested by the digestibility findings, the expected GI transit time for the diet used should be established before the main study begins. This can be done using a marker such as edible glitter.

Overall, study results suggest that EAP may influence GI function following sedation in rabbits, although the effects were not evident in gross measures such as cumulative food intake or fecal output. Instead, the observed reduction in apparent digestibility among rabbits consuming larger quantities of food after EAP treatment suggested alterations in intestinal transit consistent with enhanced GI motility. Further research into the effect of EAP on diet consumption, fecal output, and GI motility should be performed before identifying a consensus on the utility of EAP to manage gastrointestinal stasis in rabbits following sedation. Although findings from this study would be considered inconclusive regarding an electro-acupuncture promotility effect; reporting these results remains important so that future investigations can build upon this initial clinical exploration of acupuncture in a companion exotic animal species rather than repeat previously attempted approaches. The topic is also of broad clinical relevance, as rabbits are commonly kept as companion animals worldwide and are treated by both general practitioners and veterinarians specializing in exotic species.

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Declaration of Interest and Funding

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FOOTNOTES

- a. Charles River Laboratories, Wilmington, MA, USA
 - b. Allentown Brand, Allentown, NJ, USA
 - c. Mazuri® Timothy Hay-based rabbit diet, Mazuri Exotic Animal Nutrition, Arden Hills, MN, USA
 - d. Ketamine hydrochloride injection, Dechra Veterinary Products LLC, Overland Park, KS, USA
 - e. Dexdomitor® injectable solution, Zoetis Inc, Parsippany, NJ, USA
 - f. Antisedan® (atipamezole hydrochloride), Zoetis Inc, Parsippany, NJ, USA
 - g. <http://www.random.org>
 - h. Jing Mei EE12 – Electro Acupuncture Unit JM-3A Small Animal, Wuxi Jiajian Medical Instrument Inc, Wuxi, China
 - i. Jing Mei sterile acupuncture needles, 32#×1", 0.25×25 mm, Dr. Xie's Jing Tang Herbal Inc, Ocala, FL, USA
 - j. IBM SPSS Statistics, version 31, International Business Machines Corporation, Armonk, NY, USA
 - k. R Core Team, version 4.3.2, The R Foundation for Statistical Computing, Vienna, Austria
-

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