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Personal Interaction with a Reiki Practitioner Decreases Noise-Induced Microvascular Damage in an Animal Model

ANN L. BALDWIN, Ph.D.,[1] and GARY E. SCHWARTZ, Ph.D.[2]

ABSTRACT

Objective: To determine whether Reiki, a process of transmission of healing energy, can significantly reduce microvascular leakage caused by exposure to excessive noise using an animal model.

Rationale: Reiki is beginning to be used in hospitals to accelerate recovery. Despite many anecdotes describing Reiki's success, few scientific studies are reported and none of those use animals. Animal models have the advantage over human subjects in that they provide well-controlled, easily interpretable experiments. The use of noise is relevant to hospital patients because of the excessive ambient noise in hospitals in the United Kingdom and United States. Loud noise can lead to several nonauditory disorders in humans and animals that impair recovery. In the rat, stress from noise damages the mesenteric microvasculature, leading to leakage of plasma into the surrounding tissue.

Design: One group of four rats simultaneously received daily noise and Reiki, while two other groups received "sham" Reiki or noise alone. A fourth group did not receive noise or additional treatment. The experiment was performed three times to test for reproducibility.

Outcome Measures: Average number and area of microvascular leaks to fluorescent albumin per unit length of venule.

Results: In all three experiments, Reiki significantly reduced the outcome measures compared to the other noise groups (sham Reiki and noise alone) ($p < 0.01$).

Conclusions: Application of Reiki significantly reduces noise-induced microvascular leakage in an animal model. Whether or not these effects are caused by Reiki itself, or the relaxing effect of the Reiki practitioner, this procedure could be useful for minimizing effects of environmental stress on research animals and hospital patients.

INTRODUCTION

Reiki is a fast growing complementary and alternative medicine (CAM) technique used by approximately one million practitioners worldwide, and in at least one hundred hospitals in the United States.[1] A thorough review of the Reiki programs in several hospitals can be found at: www.reiki.org/reikinews/reiki_in_hospitals.html One reason for the rapid growth of Reiki lies in its simplicity and ease of application. During the last decade or so, there has been a surge in the use of CAM treatments, emphasizing the need for research to understand if, how, and why they work, and to evaluate their effectiveness.[2] A survey conducted at Boston's Beth Israel Hospital[3] found that one in every three Americans has used CAM care, spending over 14 billion dollars (not covered by insurance) in 1990 alone. However, despite the hundreds of accounts describing Reiki, there are only a handful of publications in peer-reviewed journals; therefore, there is little quantitative science to support the use of Reiki in hospitals and elsewhere. The few published scientific studies of Reiki relevant to the present experiment are summarized as follows. Olson and Hanson[4] explored the

[1]Department of Physiology, College of Medicine, University of Arizona, Tucson, AZ.
[2]Department of Psychology, Center for Frontier Medicine in Biofield Science, University of Arizona, Tucson, AZ.

usefulness of Reiki as an adjuvant to opiod therapy in pain management. In this controlled study, cancer patients were given either opioids plus "hands-on" Reiki to relieve their pain, or opioids and rest. However, although the patients who received Reiki felt better, they still requested the same dosage of opioids as the control group. Reiki also was used in the operating room on 11 patients undergoing open-heart surgery and transplantation.[5] In this study it was reported that none of the patients experienced the usual postoperative depression, the transplant patients experienced no organ rejection, and the bypass patients experienced no postoperative pain or leg weakness. In another study, Reiki produced improvements in immune and nervous function in patients with chronic conditions such as multiple sclerosis, lupus, fibromyalgia, and thyroid goiter.[6] However, a fundamental problem with the existing studies is the lack of randomized placebo-controlled experiments. In addition, in order to unambiguously confirm whether or not Reiki has any measurable physiologic effects on the body, it is necessary to perform experiments both on humans and animals. No previous studies have been published on the effects of Reiki on animals.

The use of animals as experimental subjects in studies of Reiki, rather than humans, has two significant advantages: First, experimental interpretations are not encumbered by the variable of belief or skepticism regarding Reiki; and second, the living conditions of the subjects, before, during, and after treatment are strictly controlled. The present study was designed to determine whether application of Reiki reduces the deleterious effects of noise-induced stress on microvascular permeability in rats. Previous studies have shown that when rats are exposed to excess environmental noise,[7] or a daily noise (controlled amplitude and frequency spectrum) for 15 minutes,[8] leaks in the mesenteric microvessels are produced. There is evidence that these reactions are produced by a stress response rather than just the mechanical effects of sound vibration.[9]

The use of noise as a stressor is particularly relevant to hospitals because previous studies have revealed a surprisingly high noise level with numerous peaks well above what is desirable for such institutions, both in the United States[10] and the United Kingdom.[11] These observations suggest that there is little awareness in the medical community of the nonauditory effects that noise can have on the body, such as increased gastric secretion, hypoxemia in neonates, and increased stimulation of the cardiovascular sympathetic system and hypothalamus adrenocortical axis.[12–15] If Reiki could reduce the effects of noise on microvascular integrity in the rat, perhaps it could ameliorate the potential physiologic damage suffered by patients in noisy hospitals. The present study used placebo-controlled experiments on animals to decisively answer the question: "Does Reiki reduce noise-induced deleterious effects on the microvasculature?"

MATERIALS AND METHODS

Preexperimental treatment of rats

Male Sprague Dawley rats weighing 300 to 350 g were obtained from Harlan (Indianapolis, IN). Rats were selected because they are used extensively in animal research. The rats were housed in a small, quiet facility with low personnel activity, and the rooms that were used were remote from noisy air vents and cage washers. On arrival the 16 rats were divided into four groups and housed in four separate but similar rooms, two rats per cage and two cages per room. The rats in all rooms were on similar diets and light cycles. A technician entered all rooms once a day to feed and tend to the rats. The time and sequence of room entry by the technician was randomized.

Experimental protocol

The animals in three of the rooms were subjected to 15 minutes of 90 dB white noise at 8:00 AM every day for 3 weeks, whereas the animals in the fourth room were the quiet control group. One of the noise groups received a daily Reiki treatment (15 minutes per cage) prior to the noise. The animals in a second noise room received sham Reiki in which a student was present at the same time that the Reiki practitioner was in the "Reiki" noise room. The student imitated the physical movements of the Reiki practitioner. In another study not involving Reiki, the noise and quiet rooms were reversed and similar results were obtained regarding microvascular leakage as when the initial room selection was used. Thus, the microvascular leakage results obtained from rats housed in these rooms were only affected by differences in protocol and were not confounded by differences between the rooms.

After 3 weeks, the four groups of rats were anesthetized and surgeries performed, in an order randomized with respect to pretreatment, to compare the extent of microvascular damage as judged by increased leakiness to fluorescent albumin. The person performing the surgeries and the person acquiring and analyzing the data were both blinded as to the grouping of the animals. Surgeries were completed within the next 2 weeks; during this time the respective pretreatments were continued with the remaining animals. After the surgeries were finished, the whole experiment was repeated (four rats per group) but with a different Reiki practitioner and different sham Reiki student in order to test whether Reiki *per se* was affecting the results, or merely differences in the personalities of the Reiki practitioner and student. Finally, to test for reproducibility, the experiment was repeated (four rats per group) with the same Reiki practitioner and sham Reiki student as used for the first repeat.

Methodologies

The key experimental methodologies were as follows: (1) generation of white noise; (2) application of Reiki; (3) cannulation and perfusion of rat mesentery; and (4) assessment of venular leakage (epi-fluorescence microscopy).

Generation of white noise. The background noise in the animal rooms was measured using a microphone (response uniform to 40 kHz) that was rotated in both horizontal and vertical planes to give an average reading. These readings indicated a homogenous sound field within the rooms at a fairly constant low level of 50 dB SPL. A frequency spectrum of the background noise in the four room showed that they were very similar. The white noise was generated from an audio recording (90 dB) that was played in a looped mode using a CD player and transmitted to three rooms. Loudspeakers were selected that reproduce frequencies in the range of 50 Hz to 10 kHz, and the noise level was adjusted to 90 dB averaged over those frequencies.

Application of Reiki. Although most of the published scientific studies on Reiki involved physical touch, this is not necessary in order for Reiki to be effective. For that reason, and because touch introduces another variable into the experimental design, Reiki was applied to the rats a short distance from their cages. Reiki and sham Reiki were performed for 15 minutes per cage, and both rats in a given cage received the treatments simultaneously. Both Reiki practitioners were female; the first "sham" student was female and the second "sham" student was male. Both Reiki practitioners were trained to Level 2, following the traditional lineage of the Usui System of Natural Healing and had practiced Reiki on self, family, and friends for 3 years. The sham Reiki practitioners had no knowledge of Reiki, or of any other healing modality. Each Reiki and sham Reiki practitioner positioned the palms of his or her hands, facing the cage, about four feet from the front of the cage. The sham Reiki practitioners were asked not to think about the rats, whereas the Reiki practitioners focused their full attention on the pair of rats to which they were sending Reiki.

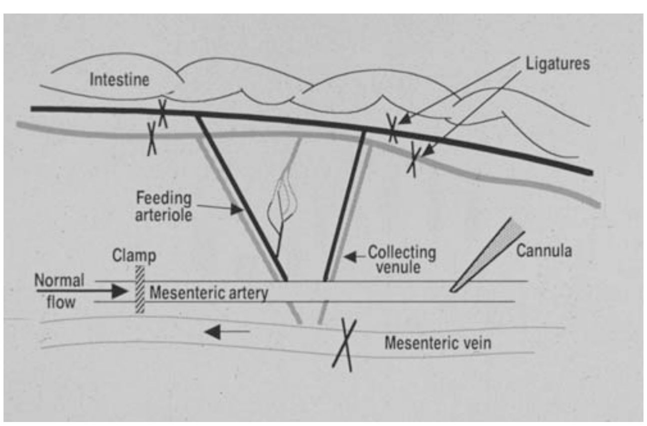

FIG. 1. Diagram depicting the surgical preparation of the mesenteric microcirculation.

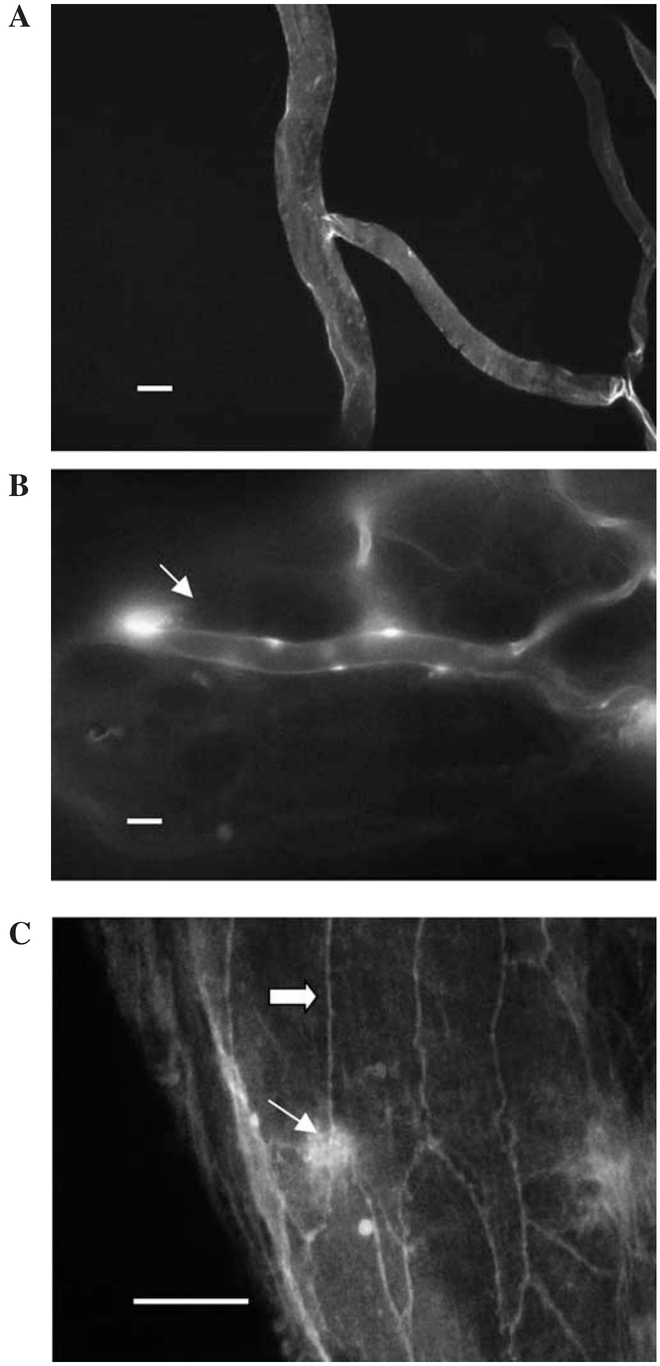

FIG. 2. Panels (**A**) and (**B**) show light micrographs of rat mesenteric venules that were perfused *in situ* with fluorescently labeled albumin. The image shown in panel (**A**) is from an animal that was subjected to noise but also received Reiki, whereas the image in panel (**B**) is from an animal that received noise alone. Note the focal regions of leakage of fluorescent albumin (*arrow*). Scale bar: 25 μm. Panel (**C**) shows a confocal image of a mesenteric venule from an animal treated with noise alone. This mesenteric network was perfused with fluorescent albumin and later fixed and stained with rhodamine phalloidin to demonstrate endothelial actin (*block arrow*) around the periphery of each endothelial cell. Note that the albumin leaks occur at the cell junctions (*arrow*). Scale bar: 10 μm.

There was no direct contact or talking to the animals. The order in which each pair of rats in the Reiki room or sham room were given Reiki or sham Reiki, respectively, was alternated on a daily basis.

Cannulation and perfusion of rat mesentery. The authors have developed a preparation of the rat mesentery in which the microvasculature of a series of 3–4 contiguous mesenteric windows is perfused. A window is defined as the mesenteric tissue between two pairs of feeding arterioles and collecting venules (Fig. 1). Details for this procedure and those for assessment of venular leakage are described in a previous publication.[16] Briefly, each rat was anesthetized with a ketamine/ACE cocktail, followed by an intraperitoneal injection of sodium pentobarbital (6 mg/100 g body wt). The abdomen was slit along the linea alba and a well-vascularized mesenteric window was selected and spread out flat over a small gauze platform. Next, the superior mesenteric artery was cannulated close to the selected mesenteric window and the appropriate arterioles and venules bordering the window were clamped to allow perfusion only of the chosen windows. The mesenteric windows were then flushed clear of blood with buffered saline, pH 7.4.

Assessment of venular leakage (epi-fluorescence microscopy). After flushing the microvascular network free of blood, the animal was killed by intravenous injection of Beuthanasia. Immediately after sacrifice, the mesenteric vasculature was perfused with 0.05% FITC-albumin (Sigma, St. Louis, MO), in buffered saline, to test for venular leaks. As soon as the microvasculature was filled with tracer, the pressure was adjusted to 20 mmHg, and the portal vein, which acts as the flow outlet, was clamped. After treatment for 1 minute, the clamp was removed and the microvascular networks were perfusion fixed. The mesenteric tissue was carefully excised for observation using epifluorescence microscopy. The extravasated albumin was fixed in place, and continued to mark leaky sites after the tissue had been excised and mounted.

An assessment of overall vascular leakage was performed by measuring the number and area of regions with extravascular FITC-albumin. Images of each microvascular network, produced by epifluorescence, were viewed on a monitor and video recorded. The length of time for which each slide was exposed to fluorescence was standardized. Videotaped images were later analyzed using NIH-Image (public domain analysis program developed by Research Services Branch, National Institute of Mental Health). The images were coded and analyzed by a technician who did not know the code, in order to eliminate bias. The following measurements were made on the images: the length and diameter of each venule (both leaky and nonleaky), the number of leaks per venule, and the area of each leak. Data were pooled for each group, and the following parameters were calculated: (1) average number of leaks per micron of venule length (venules without leaks were included in this average), and (2) average leak area per micron of venule.

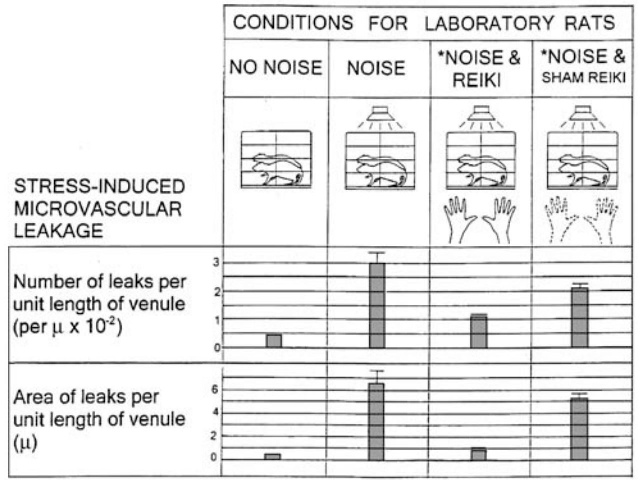

FIG. 3. Diagram to illustrate the four experimental groups, together with the experimental data obtained from each group. The data are pooled from the original experiment (1) and the two repeat experiments (2 and 3). Error bars indicate standard error of the mean (SEM). The numerical data (number of leaks per μ venule length) were as follows for quiet, noise alone, noise plus Reiki, and noise plus sham Reiki, respectively: 0.0044 ± 0.0006 (SEM) (n = 341), 0.0305 ± 0.0030 (n = 294), 0.0109 ± 0.0008 (n = 397), and 0.0207 ± 0.0014 (n = 304). The corresponding data for area of leaks per μ venule length (μ^2/μ), in the same order, were as follows: 0.4456 ± 0.0992 (SEM), 6.6040 ± 0.8809, 0.9707 ± 0.1087, and 5.1299 ± 0.5988.

Statistical analysis

Each parameter was compared between different groups using the Kruskal-Wallis test because the data did not approximate normality. If a significant difference was found between groups, pair-wise multiple comparisons were performed using Dunn's methods. All values are presented as mean ± SEM. The n used was the number of venules examined per group because this was the item of measurement. Although the type of statistical analysis, in which the n value refers to the number of venules, has been used elsewhere for microvascular leak data,[16–18] the authors decided, in addition, to use another more stringent test in this case because of the extraordinary nature of the results. Rather than using the number of venules as the item of measurement, the number of microvascular networks was used. This choice avoids the assumption that the propensity for each venule to form leaks in response to stress is an independent variable. A previous study[19] we showed that when the number of leaks was counted and measured in a whole microvascular network, this was indeed an independent measure. This type of statistical analysis was applied to Experiments 2 and 3 (tissues from experiment 1 having already been discarded).

RESULTS

Most (80%–90%) of the venules observed in the microvascular networks of the quiet control group were free of leaks of fluorescent albumin (Fig. 2A) because the endothelial junctions in intact vessels are too narrow (~5 nm) to allow for the passage of a molecule as large as bovine serum albumin (Stokes Einstein diameter 7 nm).[20] However, a large proportion (55%–70%) of the venules observed in the group receiving noise alone, or noise and sham Reiki, showed multiple leaks (Fig. 2B). Staining the mesenteric tissues with rhodamine phalloidin to reveal the endothelial junctions, and examining the microvascular networks using confocal microscopy, showed that the leaks usually occurred at the cell junctions (Fig. 2C), and thus did not involve damage to the main body of the cell.

Figure 3 shows the pooled results from the three experiments for each of the four groups. Mean numbers and areas of leaks, per unit length of venule for all noise groups, including noise plus Reiki, were significantly greater than for the quiet group ($p < 0.01$). Values for noise plus Reiki and noise plus sham Reiki were both significantly less than noise alone ($p < 0.01$ and $p < 0.05$) for leak numbers. This result was duplicated for leak area in the noise plus Reiki group ($p < 0.01$). Most importantly, both for leak number and area, the values for noise plus Reiki were significantly less than those for noise plus sham Reiki ($p < 0.01$).

Similar results were obtained when the data from the three experiments were treated separately, as illustrated in Figures 4A,B. In all three cases, the value for noise plus Reiki was significantly less than that for noise plus sham Reiki. The size distribution of the leaks for the noise plus Reiki and noise plus sham Reiki groups was consistent with this finding. For example, in the noise plus Reiki group, 78% of the leaks were less than 10^{-3} μ^2 in area, compared to 57% of leaks in the noise plus sham Reiki group. Also, for the noise plus Reiki group the maximum leak size was 6×10^{-3} μ^2, whereas for the noise plus sham Reiki group there was a continuous spectrum of leak sizes up to 10×10^{-3} μ^2. When results from the two different Reiki practitioners were compared (Experiments 1 and 2, Figs. 4A,B) no significant difference was seen for leak number or area, supporting the idea that the reduction in leakage was caused by the Reiki, rather than by a particular person.

The effects remained significant when analyses were performed on number of microvascular networks rather than individual venules for the second and third experiments. When combining the results from the two experiments, there were 27 networks for noise plus Reiki and 19 networks for noise plus sham Reiki. The analysis showed a significant difference between these two groups for leak number ($p < 0.01$) and leak area ($p < 0.05$). Treating the two experiments separately gave similar results to those obtained by combining the experiments with $p < 0.05$ for number and area.

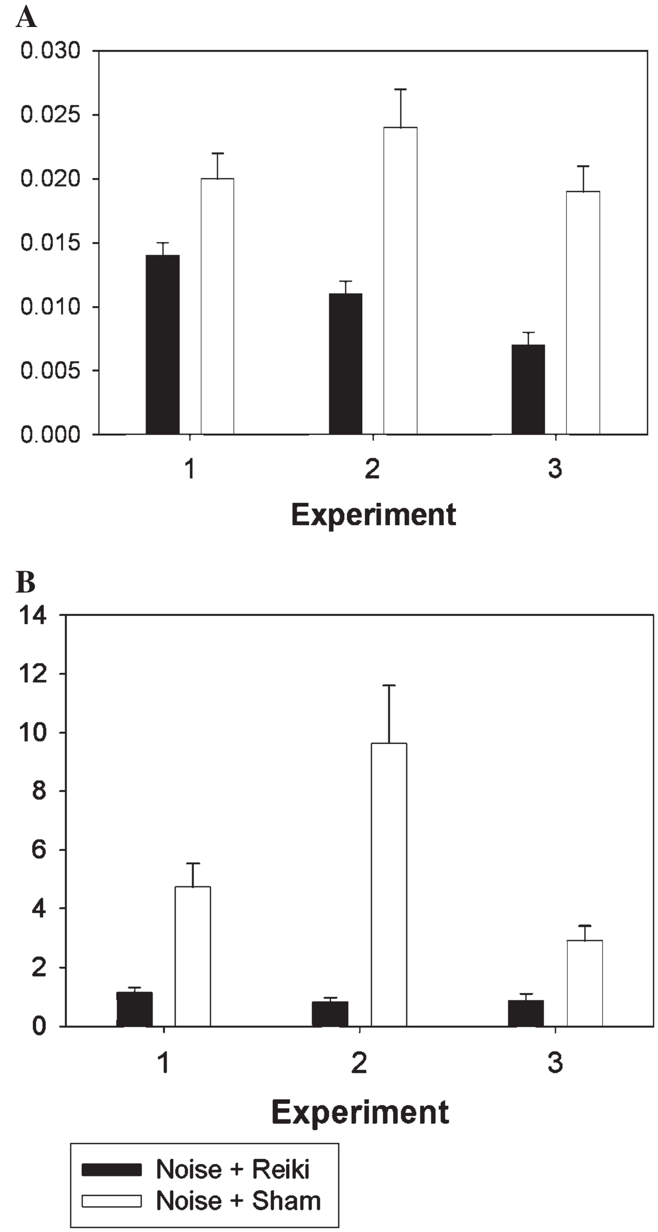

FIG. 4. **A** and **B**: Effect on Reiki on vessel leakage (number of leaks/μ vessel length). Graphs show average number and area of albumin leaks per unit length (microns) of venule. Shaded bars demonstrate data from animals that received noise and Reiki, and open bars show data from those that received noise and sham Reiki. Error bars represent standard error of the mean.

DISCUSSION

Statement of principal findings

Application of Reiki to rats that were stressed by noise significantly reduced microvascular leakage.

Strengths and weaknesses of the study

This study is the most rigorous test of the efficacy of Reiki that has been performed, first because the Reiki groups were compared with sham Reiki controls, and second because an animal model was used, thus removing problems with variations in diet and lifestyle, and the complications with attitude that are encountered when using human subjects. One possible weakness is that only two Reiki practitioners were used. However, this is a "proof of concept" study; therefore, it would not have been expedient to recruit more practitioners, especially if the result had been negative.

Strengths and weaknesses in relation to other studies. There are very few published scientific studies of Reiki that are relevant to the present experiment because this is such a new and controversial area. One study, currently being performed at Portsmouth Regional Hospital (Portsmouth, NH) is showing that Reiki helps patients reduce their stress levels preoperatively and induces a calming effect that assists in decreasing the amount of pain medication required postoperatively.[21] These results support the idea of researching into the potential benefits of Reiki for use in a hospital setting. Another study[22] indicates that Reiki can reduce emotional stress in people. Healthy individuals were given a 30-minute Reiki treatment, and comparing before and after measures, there were significant reductions in anxiety and systolic blood pressure and a significant increase in salivary immunoglobulin A (IgA). Fifteen subjects showed decreased plasma cortisol concentrations after treatment. In contrast, during periods of stress, salivary IgA is reduced[23] and plasma cortisol increased.[24] Therefore, these results indicate that the stress response was decreased in most cases after Reiki. However, this study did not demonstrate that it was Reiki that reduced the stress response because no sham Reiki control subjects were included. Thus the results may have been produced by an effect of being in a quiet room with a caring person rather than by Reiki *per se*.

The present study is a more rigorous test of Reiki than those reported in the literature, first because it is the only one that involves animals (and thus eliminates variations in diet and lifestyle that are present in human studies), and second because it demonstrates repeatability under the same conditions. In addition, every outcome parameter was quantifiable; thus, the measures did not rely on the subjective assessments of pain relief or general state of health that are common in the other studies. Finally, the inclusion of a sham Reiki group provided an excellent control.

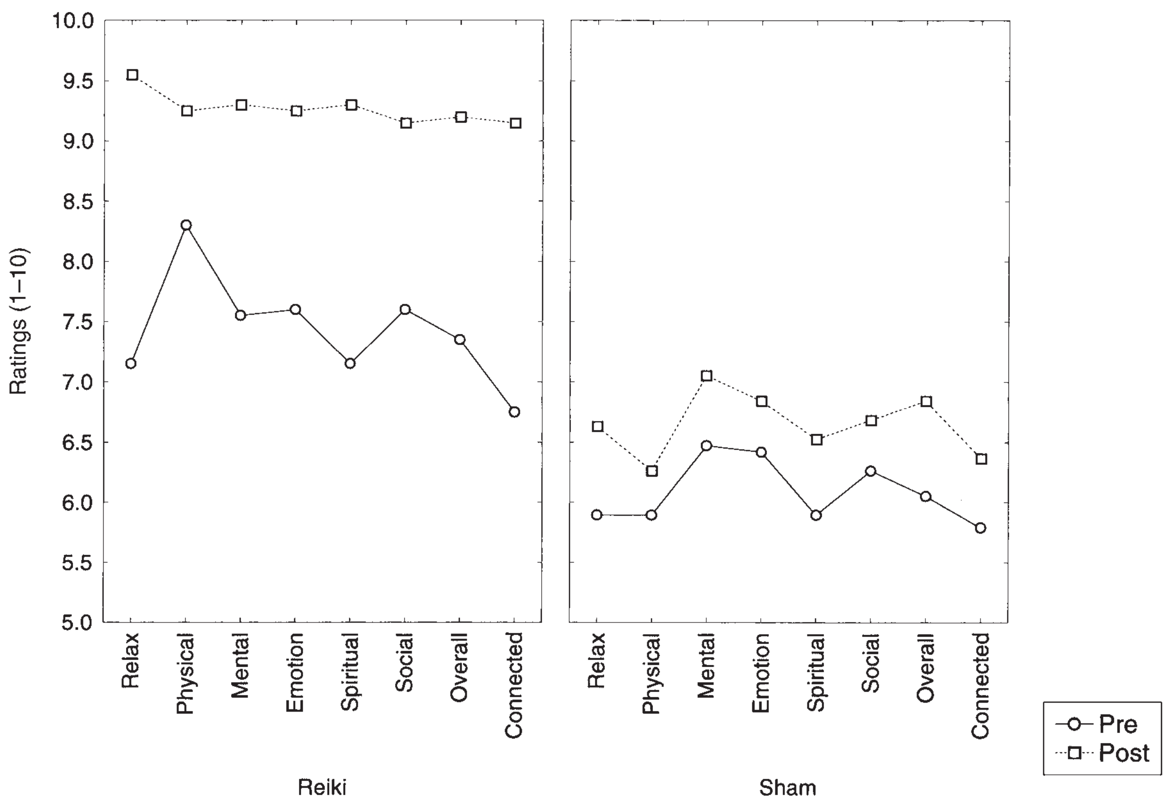

FIG. 5. Reiki versus sham: pre- versus post-treatments and individual ratings. Graphs show pre (*solid lines*) and post (*dashed lines*) ratings in Reiki practitioner (*left panel*) and Sham control (*right panel*), averaged more than 21 sessions. Not only are the overall ratings higher in the Reiki practitioner, but the increase post- versus pre-treatment is greater in Reiki compared to sham, $F(1,74) = 14.82$, $p < 0.001$.

Meaning of the study

One question that this research raises is, "How did the Reiki reduce the noise-induced microvascular leakage?" There is evidence that exposure to excessive noise stimulates peripheral nerves in the intestine to release neurotransmitters that may damage microvessels directly as well as promoting mast cell degranulation and subsequent release of inflammatory mediators that cause further damage.[25] Preliminary studies[26] indicate that Reiki has some effect on the autonomic nervous system. Thus, perhaps Reiki reduces the stimulation of peripheral nerves in the intestine and mesentery and hence decreases the release of neurotransmitters. Although it may be difficult to believe that energy healing can actually impinge on physiologic systems, such as nerves and cells, one other study has shown that bioenergy, a general term that encompasses Reiki, can directly affect the concentration of intracellular free calcium.[27]

On the other hand, it is possible that the rats may have been reacting to physiologic and/or psychologic changes that occurred in the Reiki practitioners, rather than to the Reiki itself. This idea is supported by daily evaluations of the overall state of Reiki and sham Reiki practitioners pre- and post-administering treatments throughout Experiment 3. During Experiment 3, the Reiki practitioner and the "sham" student completed a questionnaire rating their mental, emotional, and spiritual states, before and after performing each treatment. The results (Fig. 5) show that the ratings increased much more post-treatment versus pretreatment for Reiki than for sham Reiki. Therefore, further experiments are required, using the same animal model in which Reiki is given remotely, so that the practitioner does not have to enter the room. If similar results were obtained in such a study, they could not be explained by the animals merely responding to changes in the Reiki practitioner.

CONCLUSIONS

Whether or not the effects of Reiki result from a putative bioenergy or the relaxing effect of the Reiki practitioner, this procedure could still be useful for minimizing the effects of environmental stress on research animals[28] and perhaps on humans. Further rigorous, placebo-controlled experiments are needed to determine the effectiveness of Reiki for reducing the deleterious physiological consequences of excessive noise throughout the body.

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The animal experiments were conducted under the guidelines, and with the approval of, the Institutional Animal Care and Use Committee of the University of Arizona.

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Address reprint requests to:
Ann L. Baldwin, Ph.D.
Department of Physiology
College of Medicine
University of Arizona
Tucson, AZ 85724-5051

E-mail: abaldwin@u.arizona.edu