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Acupressure and quality of sleep in patients with end-stage renal disease—a randomized controlled trial

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Abstract

The purpose of the study is to test the effectiveness of acupressure on sleep quality of end-stage renal disease patients. The study was a randomized controlled trial; qualified patients in the dialysis centers of four major hospitals were randomly assigned into an acupressure group, a sham acupressure group, and a control group. A total of 98 participants were included in the study. The main outcomes measured were the Pittsburgh sleep quality index (PSQI) and the sleep log. Data were collected at pretreatment and following treatment. Primary statistical analysis was by means of Analysis of Covariance, the Kruskal-Wallis Test and repeated measure ANOVA. The results indicated that PSQI scores of the acupressure group have a significantly greater improvement ($p<0.01$) than the control group. However, there were no differences between the acupressure group and the sham group or the sham group and the control group ($p > 0.05$). Subscales of PSQI were further analyzed. Results demonstrated significant differences between the acupressure group and the control group in subjective sleep quality ($p = 0.009$), sleep duration ($p = 0.004$), habitual sleep efficiency ($p = 0.001$), and sleep sufficiency ($p = 0.004$). Significant differences in the subscale of subjective sleep quality ($p = 0.003$) between the sham acupressure group and the control group were also observed.

Sleep log data showed that the acupressure group significantly decreased awake time and improved quality of sleep over time more than the control group ($p<0.01$). The improvement could be seen as soon as the acupoints massage was implemented, and it was maintained through the post intervention.

Keywords: Acupressure; Quality of sleep; ESRD

1. Introduction and literature review

Renal professionals are often aware that sleep alterations are common in patients with end stage-renal disease (ESRD) as complaints are frequently encountered in clinical practice. In fact, a high prevalence of subjective sleep complaints has been documented with this problems reported by 50–80% of patients studied (Holley et al., 1992; Walker et al., 1995). Many studies have identified that these patients have a high incidence of sleep disorder such as sleep apnea syndrome, periodic leg movement disorder, and restless legs syndrome (Pressman et al., 1995; Wadhwa and Mendelson, 1992; Winkelman et al., 1996). Sleep disturbance may lead to daytime sleepiness and decreased mental acuity, thus, negatively influencing the ability of ESRD patients to function and affecting their subjective quality of life.

Although sleep disturbance is the most important and bothersome symptom experienced by these patients, there are few documented interventional studies that have addressed this problem. Thus, there is a need to develop effective methods to manage sleep disturbance of ESRD patients. Acupressure has been studied and offered as a valuable treatment in improving the quality of sleep in the gerontology population (Chen et al., 1999; Tzou, 1994). Therefore, the purpose of this study is to

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investigate the differences in quality of sleep among those ESRD patients receiving usual care plus acupressure treatment, sham acupressure plus routine care and those receiving usual care.

Acupressure or acupuncture involves stimulating specific anatomic points in the body for therapeutic purposes. It is believed that it works by correcting the balance of qi in the body. Qi flows through the 12 major energy pathways called meridians, each linked to specific internal organs or organ systems and 365–2000 acupoints (Freeman and Lawlis, 2001; Sandifer, 1997). Acupressure or acupuncture has been researched and found to alleviate lower back pain, headaches, osteoarthritis pain, neck pain, musculoskeletal pain, pain before and after surgery, postoperative and chemotherapy-induced nausea, and managing sleep disturbance in chronic illness patients (Chen et al., 1999; Dibble et al., 2000; Freeman and Lawlis, 2001).

There are a number of theories as to how acupressure or acupuncture works. First, acupressure alters brain chemistry by affecting the release of neurotransmitters and neurohormones (Wu et al., 1994, 1995). Second, it activates opioid systems, which is believed to account for the well-proven effects of these methods on pain (Takeshige and Sato, 1996). Third, it speeds up the transmission of electromagnetic signals that may activate the flow of endorphins and monoamines, and in turn, reduce levels of agitation and nausea (Dale, 1997; Dibble et al., 2000; Dold, 1998). However, these theories or functions need to be empirically supported through research.

Sleep disturbances are frequently reported symptoms by ESRD patients. The prevalence rate of sleep alteration reported in studies ranges from 50% to 80% in dialysis patients (Holley et al., 1992; Walker et al., 1995). Researchers have documented that ESRD patients reported significantly poorer subjective quality of sleep in comparison to the general population (Holley et al., 1992; Parker, 1996). Early identification of sleep problems and interventions to improve sleep quality is essential, because sleep disturbance that persists for a long period of time could decrease general health and functioning (Foley et al., 1995).

Parfrey et al. (1988) studied the prevalence and severity of several nonspecific symptoms in 97 dialysis patients, and found that sleep disturbance was one of the seven most common and important symptoms. The six other most prevalent symptoms respectively were tiredness (79%), cramps (57%), pruritus (49%), dyspnea (47%), headaches (41%), and joint pain (44%). Other researchers have also identified that sleep disturbance was the most prevalent symptom in dialysis patients (Barrett et al., 1990).

The experiences of sleep alteration in ESRD patients have been studied. Holley and colleagues (1992) surveyed 70 dialysis patients, and reported sleep disturbance experienced mainly included trouble falling asleep (67%), nighttime waking (80%), early morning waking (72%), restless legs (83%), and jerking legs (28%). However, Walker et al (1995) found daytime sleepiness was the most commonly reported problem (66.7%) followed by restless legs syndrome (57.4%).

Medications may interfere with sleep. Foley and colleagues (1995) found that the use of anxiolytic or barbiturate prescriptions were associated with a 50% increase in insomnia among elderly patients. Furthermore, sleep disturbance can interfere with patient's activities of daily living, increase accidents, and reduce quality of life (Foley et al., 1995; Johnston, 1995).

Although subjective estimates of sleep quality may not necessarily correlate with objective measurements performed in a sleep laboratory by polysomnography (PSG), Naylor and Aldrich (1994) recommend that subjective descriptions be included since they are often similar to those measurements and can provide vital information. In addition, self-report data on sleep habits have provided information about the effects of psychological distress that are not provided by polygraphic measures in a sleep laboratory setting (Pilcher and Ott, 1998).

The studies discussed above provided important information indicating that sleep alteration complaints are extremely common in ESRD patients. Sleep disturbance is the most important and bothersome symptom experienced by these patients. Despite this significant sleep alteration in the ESRD population, no interventional studies have addressed this problem. Clearly, there is a need to develop and to test interventions that effectively assist patients in managing their sleep problems. Since, the effectiveness of acupressure therapy has been studied and found to significantly improve the quality of sleep in elderly patients (Chen et al., 1999; Wang, 1997). This research is to develop a specific acupoints massage and to test its effectiveness in improving quality of sleep among ESRD patients.

2. Methods

2.1. Acupressure intervention

Following the pretest of study variables, ESRD patients received acupressure massage three times a week for four weeks; in addition, patients were instructed not to massage any acupoints during the study period. Researchers developed an acupressure protocol based on literature reviewed and consultation with licensed traditional Chinese Physicians, who had graduated from medical school in Taiwan and had practiced acupuncture for more than 10 years. To

control for the validity and reliability of the acupressure intervention, the protocol was set up as follows:

Three acupoints were selected to enhance sleep. They were Shenmen (HT7) in the ears and hands, and Yungchuan (K11) in both feet. These acupoints were chosen for subjects in the acupressure group. The precision of acupressure was confirmed if the subjects felt sore, numb, heavy, distended, and/or warm. Non-acupoints (sham acupressure), which were 1 cm (corresponding to body unit) away from meridian, were used to replace true acupoints. Time of interventions was limited to 14 min, consisting of 5 min of massage to relax the person and 9 min of acupoints massage (3 min/acupoints). One course of intervention lasted for 3 days per week. These interventions were carried out for 4 consecutive weeks.

An acupressure treatment expert trained the investigator and research assistants for a month prior to the study. Applying consistent pressure on the correct acupoints of Shenmen and Yungchuan on the same patient to assess the reliability and validity of acupressure treatment. A scale was used (20 gm–6 kg) to measure the force of finger pressure between 3 and 4 kg (Huang, 1991). The force of finger pressures was measured 20 times with the mean forces of fingers of left and right hands were from 3.56 to 3.88 kg (SD = 0.15–0.33). Accuracy of acupoints selection was also evaluated in patients. Ten subjects were selected to determine research assistants' correctness in selection of acupoints by two experts, and who confirmed with 100% accuracy.

2.2. Study design

The study is a randomized controlled trial. Adult patients undergoing hemodialysis routinely for ESRD were randomized into experimental (receiving an acupressure plus usual care), placebo (receiving sham acupressure plus usual care), or control groups (receiving usual care).

The experiment group received acupressure intervention; the acupoints were chosen from the ears, hands and feet. The placebo group received a massage at locations with no acupoints at same frequency as the experiment group. The control group only received unit routine care. Pretreatment measures were administered prior to randomization, and posttreatment measures were collected approximately 1 week after the treatment.

2.3. Subjects and setting

The setting of the study was four dialysis centers in major hospitals in Taipei, Taiwan. The eligibility criteria included (a) ESRD patients who complain of sleep disturbance; (b) age 18–65 years; (c) clear mental status with no dementia; (d) able to communicate; and (e) afternoon dialysis subjects. Exclusion criteria included: (a) DSM IV psychiatric diagnoses; and (b) persons with major chronic illness such as insulin-dependent diabetes, cancer, or lupus erythematosus were disqualified. The afternoon patients were selected because they would rise at approximately the same time every day and stay awake during their treatment (Puntriano, 1999).

2.4. Measures

Quality of sleep was measured by using the *Pittsburgh sleep quality index* (PSQI, Buysse et al., 1989) that was developed to screen patients with sleep quality and disturbance. The 19 items were used to generate seven component scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, sleep sufficiency and the use of sleeping medications. Items were scored from 0 (no difficulty) to 3 (severe difficulty). The sum of the scores for the seven components gives a global score. The PSQI can differentiate those with no sleep problem, major depression disorder, disorder of initiating sleep, and disorder of excessive somnolence with an identification accuracy of 88.5%. The sensitivity and specificity of the PSQI were 89.6% and 86.5%, respectively. A global score over 5 yields a diagnostic sensitivity of 90% and specificity of 87% in distinguishing good and poor sleeper (Buysse et al., 1989). The Chinese version of the PSQI was used for this study; this version has been documented with supports of reliability and validity (Chen et al., 1999; Tzou, 1994). The internal consistency of the scale was further supported with a Cronbach's alpha of 0.86 in this study.

A sleep log was used to monitor sleep daily. Sleep quality was rated using a descriptive, numeric scale ranging from 0 (worst sleep imaginable) to 10 (sleep well). Ratings were performed on a daily basis, prior to getting out of bed. Participants recorded when they woke up and the frequency of their nocturnal awakenings. Sleep log is widely used in clinical and research settings. Although reliability and validity of the daily log are rarely reported, researches have compared the daily log with polysomnographic monitoring, and found that objective data and subjective data were highly agreeable (kappa = 0.87), and that sensitivity and specificity were also high (92.3% and 95.6%) in narcoleptic subjects and control subjects (Rogers et al., 1993). Researchers concluded that the log could provide accurate information about sleep/wake patterns.

2.5. Procedures

The protocol received institutional review board approval. The researcher and the assistant approached potential participants about the study in the dialysis centers of four major hospitals. First, all the potential subjects of 225 patients were screened to identify those

with sleep disturbance. After consenting to participate, 105 subjects were stratified by gender and age, and then blind randomized to acupressure treatment plus usual care, sham acupressure plus usual care, or routine care groups. A total of 98 patients finished this study. Only the researcher and the acupressure nurse were aware of which treatment the patients were receiving. The patients care providers (physicians, nurses, dieticians, social workers), and two trained research assistants, who collected all the data, were uninformed as to the participants' treatment group.

2.6. Data analysis

The SPSS (Version 10.0) statistical software package was used for data entry and analysis. Descriptive statistics were generated related to sample characteristics and other variables of interest. Repeated measure ANOVA, ANCOVA and the Kruskal-Wallis test were used to answer research questions. These analysis techniques are quite robust with small sample size and statistical assumption violations.

3. Results

3.1. Demographic data of subjects

The typical participants were 55.52 years old (SD = 12.98), female (54.8%), married (82.7%), and retired or unemployed (88.7%). Most had graduated from elementary school (38.8%) and high school (36.7%); and were religious (76.5%). The mean renal disease severity was moderately severe (mean = 6.89, SD = 2.08, range = 1–10), and the mean length of dialysis was 60.25 months (SD = 55.84). No statistically significant differences in gender, age, education levels, consumption of milk, tea, and coffee or smoking, current use of medication, number of chronic diseases, and length of being on dialysis were seen among the acupressure, sham acupressure, or control groups ($p > 0.05$). The data indicates homogeneity of subjects across the groups.

3.2. Sleep quality of subjects

Before data analysis, the main study variables were examined for univariate and multivariate outliers and evidence of normal distribution. Based on these results, the data were transformed as necessary. Results of the means and standard deviations of pretest and posttest on quality of sleep across groups are presented in Table 1. Using a one-way ANOVA to compare mean difference on pretest data, revealed no significant differences ($p > 0.05$) on the global score of the three groups. These results indicate homogeneity of the subjects of the three study groups.

A one-way analysis of covariance (ANCOVA) was conducted to test for the effectiveness of acupressure on quality of sleep. The pretest scores of the PSQI were used as the covariance, and the posttest scores of the PSQI were used as the dependent variable. A preliminary analysis evaluation of the homogeneity-of-slopes assumption indicated that the relationship between the covariance and the dependent variable did not differ significantly as a function of the independent variable, $F(2,88) = 0.21$, MSE = 11.84, $p = 0.81$. The ANCOVA was significant, $F(2,90) = 7.01$, $p = 0.001$. The means of the PQSI, which had been adjusted for initial differences, were ordered as expected across the groups. The acupressure group had a smaller adjusted mean ($M = 7.10$), followed by the sham acupressure group ($M = 8.67$), while the control group had the largest adjusted mean ($M = 10.34$). Lower scores indicated high quality of sleep, and high scores indicated poor quality of sleep. Follow-up tests were conducted to evaluate pairwise differences among these adjusted means. The Holm's sequential Bonferroni procedure was used to control for type I error across the three

Table 1
Means of pretest and posttest of sleep quality among groups

Quality of sleep	Acupressure				Sham				Control			
	Pretest		Posttest		Pretest		Posttest		Pretest		Posttest	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Global PSQI	9.94	3.95	7.29	4.36	10.53	3.56	9.23	4.36	8.43	4.50	9.56	4.00
Sleep quality	1.56	0.82	1.03	0.83	1.90	0.82	1.27	0.83	1.47	0.73	1.60	0.86
Sleep latency	2.12	1.04	1.41	1.08	2.47	0.73	2.23	1.07	2.27	1.00	2.00	1.08
Sleep duration	1.76	1.10	1.44	0.99	1.90	1.18	1.90	1.18	1.36	1.18	1.83	1.17
Habitual sleep	1.58	1.30	1.00	1.10	1.43	1.16	1.23	1.25	1.06	1.17	1.66	1.21
Sleep disturbance	0.85	0.50	0.97	0.45	1.10	0.54	1.06	0.69	0.90	0.40	1.00	0.45
Sleep sufficiency	0.52	0.66	0.35	0.69	0.76	0.66	0.63	0.61	0.56	0.67	0.96	0.61
Sleep medication	1.41	1.51	1.20	1.47	1.00	1.38	0.86	1.30	0.73	1.20	0.60	1.16

pairwise comparisons. There was a significant difference in the adjusted means between the acupressure group and the control group, but no differences were observed between the acupressure group and the sham group or the sham group and the control group.

A Kruskal-Wallis test was conducted to evaluate differences among the three groups on median change in subscale of PSQI because these scores were not normally distributed. The test, which was corrected for tied ranks, was significant on the subjective sleep quality, sleep duration, habitual sleep efficiency, and sleep sufficiency as indicated on Table 2. Follow-up tests were conducted to evaluate pairwise differences among the three groups, using the Holm's sequential Bonferroni approach. Results indicated significant differences between the acupressure group and the control group in the subjective sleep quality ($p = 0.009$), sleep duration ($p = 0.004$), habitual sleep efficiency ($p = 0.001$), and sleep sufficiency ($p = 0.004$). Results also showed a significant difference in the subjective sleep quality ($p = 0.003$) between the sham acupressure group and the control group, but there were no differences in sleep indices between the acupressure group and the sham acupressure group.

Data points obtained from the Sleep log included pretest (1 data-point), intervention period (8 data-points), and postintervention (1 data-point). Repeated measures analysis of variance was performed to determine if there were any significant differences over time among the acupressure, the sham acupressure, and the control groups on the dependent variables. The trends of perceived quality of sleep at night and total awake time at night over time were presented at Fig. 1. The results demonstrate the group main effect was significant in perceived quality of sleep at night (F (2, 72) = 5.29, $p = 0.007$), but group X time interaction and time main effect were not significant ($P > 0.05$). Follow-up tests were conducted to evaluate pairwise differences among the three groups, controlling for type I error across tests using the Holm's sequential Bonferroni approach. Results indicated significant differences between the acupressure group and the control group on the perceived quality of sleep at night ($p = 0.002$). Results also demonstrated a significant group main effect on the awake time at night (F (2, 72) = 2.55, $p = 0.05$). Follow-up tests to evaluate pairwise differences among the three groups indicated significant differences between the acupressure group and the control group. However, frequency of nocturnal awakening did not differ significantly among the groups ($p > 0.05$).

Fig. 1 indicates that subjects in the acupressure group showed the awake time decreased from the second day of intervention and remained effective through out the study. Improvement on subjects' perception of sleep quality can be seen as early as the first acupoints massage and continued to improve through the post intervention.

Table 2
The Kruskal-Wallis test for subscale of PSQI among groups

Subscale	χ^2	df	p
PSQI			
Subjective sleep quality	10.23	2	0.006
Sleep latency	3.89	2	0.142
Sleep duration	8.29	2	0.016
Habitual sleep efficiency	11.38	2	0.003
Sleep disturbance	0.99	2	0.608
Sleep sufficiency	8.78	2	0.012
Sleeping medication	0.83	2	0.661

4. Discussion

This study found that there were significant differences in improvement of sleep among those patients with

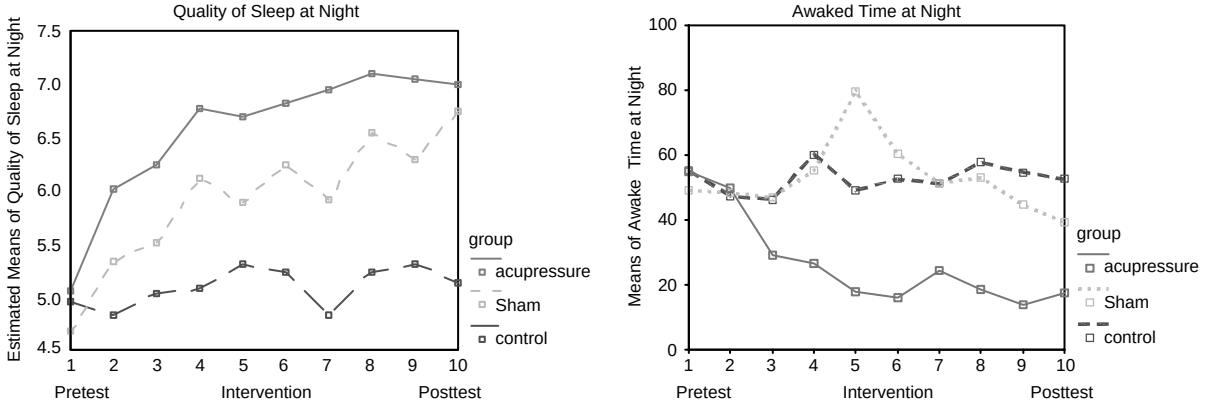

Fig. 1. The trend of quality of sleep and awake time at night among groups.

ESRD in the acupressure, sham, and control groups. Post hoc comparison pointed out that the improvements in the acupressure group were significantly greater than those in the sham acupressure and control groups. This difference in improvements may be mainly due to the effect of acupressure on various acupoints such as the Yungchuan and Shenmen. The results from this study suggest that acupressure might have an important role for managing sleep disturbances in patients with ESRD.

The findings found quality of sleep gradually improved only in the acupressure group. These findings are consistent with studies of acupressure in improving the quality of sleep for the elderly population (Chen et al., 1999; Wang, 1997). The stimulation of these acupoints may increase a release of serotonin and relaxes the body, and thus, promote sleep (Chen, 1993). Acupressure techniques can be easily taught to patients so that they can manage sleep alteration, decrease adverse health outcomes and improve their quality of life.

Although subjects in the sham acupressure group improved in the PQSI subscale of the subjective sleep quality on the results of the Kruskal-Wallis test, the improvements of quality of sleep were the greatest in the acupressure group. Massaging acupoints or non-acupoints itself may produce various level of relaxation on the body, and thus, produce different effects in sleep (Goats, 1994). The findings of this study found that acupressure could improve the PSQI global scores. In the acupressure group, we discovered that the mean score differences between before and after was 2.64. Such findings are comparable to Chen and Wang's studies. This study adds to previous research by supporting the positive effect of acupressure on the quality of sleep.

This study found acupressure could not only enhance sleep but also exhibit rapid results right after one or two acupoints massage sections. These findings are consistent with Chen's (1999) research results, and further support that acupressure is a rapid and effective method in caring for ESRD patients with sleep disturbance.

5. Limitations and implication

The strengths of this study were (a) providing health professionals with a research-based intervention, and (b) demonstrating the efficiency the acupressure and promoting a non-invasive intervention for sleep disturbances of ESRD populations. The sample was drawn from the northern part of Taiwan. Generalizability of this finding to other samples of dialysis patients from other geographical areas cannot be ensured. However, our study was a randomized trial and included experiment, placebo and control groups, results also strongly supported the effect of acupressure on the quality of sleep, we feel that the findings from this study do have potential for broad application outside of these four dialysis centers, believing that it is the intervention that influences the observed results.

One limitation of this study was the short follow-up period after treatment. Following the study, as requested by patients, patients or family members were taught acupoints massage technique. Patients were encouraged to apply acupressure on themselves at home to promote sleep. Because researchers cannot ensure the reliability and validity of acupoints massage by these patients, follow-up data were not collected. However, the majority of the patients expressed that their quality of sleep had improved overall. Future research should include longitudinal studies with a cross over design to document the long time effects of acupressure for ESRD patients.

Application of research findings to patients with sleep disturbance might have important implications for ESRD patients who are on dialysis treatment. The findings suggest that assessment of ESRD patients' sleep quality should be an essential part of nursing practice. Clinicians should consider providing acupressure as an alternative method to improving dialysis patients' quality of sleep. Nurses, patients and their families could be easily trained to administer acupressure to those who have sleep disturbance.

This study provides a foundation to conduct future studies of acupressure for managing ESRD patients with sleep disturbance. Others should replicate and expand the current study to address the research question. This study approach should be expanded to include a larger sample with longitudinal design. This would allow the researcher to say with more confidence that the acupressure was solely responsible for improving quality of sleep of ESRD patients.

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