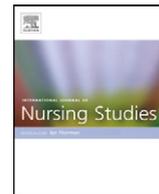




Contents lists available at [SciVerse ScienceDirect](#)

## International Journal of Nursing Studies

journal homepage: [www.elsevier.com/ijns](http://www.elsevier.com/ijns)



# The effectiveness of valerian acupressure on the sleep of ICU patients: A randomized clinical trial

Ji-Han Chen<sup>a</sup>, Yuh-Huey Chao<sup>b</sup>, Shu-Fen Lu<sup>a</sup>, Tao-Fen Shiung<sup>a</sup>, Yann-Fen Chao<sup>c,\*</sup>

<sup>a</sup> Department of Nursing, Taipei Veteran General Hospital, Taiwan

<sup>b</sup> Department of Anesthesiology, Lotung Poh-Ai Hospital, Yilan, Taiwan

<sup>c</sup> Department of Nursing, Mackay Medical College, Taiwan

### ARTICLE INFO

#### Article history:

Received 3 June 2011

Received in revised form 3 February 2012

Accepted 8 February 2012

#### Keywords:

Valerian oil  
Acupressure  
ICU patients  
Sleep time  
Sleep quality

### ABSTRACT

**Background:** Severely ill patients often experience problems with sleep. Either acupressure or valerian aromatherapy are reported as helpful in promoting sleep.

**Objectives:** The purpose of this study was to explore the effectiveness of valerian acupressure on the sleep of patients in the intensive care unit (ICU).

**Design:** A randomized clinical trial.

**Setting:** A 42-bed adult intensive care unit.

**Participants:** Forty-one subjects in the experimental group and 44 subjects in the control group.

**Methods:** The measurement included observation, and actigraphy measures during 10 pm–6 am, and the Stanford Sleepiness Scale (SSS) measures on the next morning. Experimental groups received valerian acupressure on the Shenmen, Neiguan, and Yongquan acupoints between 7 pm and 10 pm of the second day while control groups received regular treatment. Heart rate was measured for 5 min before and after valerian acupressure present for HR variability analysis to measure relaxation response.

**Results:** The results indicated that after receiving valerian acupressure, patients' sleeping hours increased, wake frequency reduced and SSS grades declined. The HR variability data indicated relaxation response immediately after valerian acupressure.

**Conclusion:** This study supports the hypothesis that valerian acupressure on the Shenmen, Neiguan, and Yongquan acupoints could improve the sleeping time and quality of ICU patients.

© 2012 Elsevier Ltd. All rights reserved.

### What is already known about the topic?

- Either acupressure or valerian aromatherapy was reported as effective for promoting sleep for chronic patients.

### What this paper adds

- This study demonstrates that valerian acupressure could improve the sleep of ICU patients.

### 1. Introduction

Severely ill patients residing in hospital frequently experience sleep problems. Factors such as the noise of physiological monitoring systems, warning alerts, lights, and frequent or complex treatments disrupt patients' sleep. These disruptions can result in sleep deprivation, which negatively influences patient recovery (Tamburri

\* Corresponding author at: Department of Nursing, Mackay Medical College, No. 46, Sec. 3, Zhongzheng Rd., Sanzhi Dist., New Taipei City 252, Taiwan. Tel.: +886 2 26360303x1310; fax: +886 2 26361267.

E-mail addresses: [hpchen@tpevgh.gov.tw](mailto:hpchen@tpevgh.gov.tw) (J.-H. Chen), [ettetw@hotmail.com](mailto:ettetw@hotmail.com) (Y.-H. Chao), [sflu@tpevgh.gov.tw](mailto:sflu@tpevgh.gov.tw) (S.-F. Lu), [tfshiung@vghtpe.gov.tw](mailto:tfshiung@vghtpe.gov.tw) (T.-F. Shiung), [yfchao.tw@yahoo.com.tw](mailto:yfchao.tw@yahoo.com.tw), [yfchaomk@mcc.edu.tw](mailto:yfchaomk@mcc.edu.tw) (Y.-F. Chao).

et al., 2004). Celik et al. (2005) and Tamburri et al. (2004) found that in intensive care units (ICUs), nurses and medical staff visit patients rooms over 40 times every night. Additionally, only 6% of patients have 2–3 h of uninterrupted sleep. When critically ill patients are deprived of sleep, their immune systems are weakened, and their ability to recover is reduced. Steroid secretions in the body increase and interfere with regular healing properties and disease resistance. Furthermore, respiratory muscle can become flaccid, affecting breathing and causing high carbon dioxide and low oxygen levels in the blood. This prolongs patient dependency on respirators and other medical equipment (Richards et al., 2003). Therefore, the sleep quality of severely ill patients is a serious issue for medical and nursing staff.

### 1.1. The effect of valerian essential oil on sleep

In ancient China, the sedative and pain-relieving properties of valerian, and its ability to promote healthy blood circulation effectively, were used to treat neurasthenia, insomnia, mania, and other illnesses (Kao, 1989). In Europe and the U.S., valerian is generally considered to be beneficial to sleep (Taibi et al., 2007). Bent et al. (2006) systematically reviewed valerian-related studies and reported that valerian can improve the sleep quality of insomniacs, with few side effects. The possible side effects of valerian, such as dizziness, drowsiness, and headaches, are not severe and occur rarely. Another systematic review conducted by Taibi et al. (2007) found that when refined valerian is absorbed by the human body, the activity of the *gamma*-aminobutyric acid (GABA) receptor is increased but its absorption is inhibited. The medicinal effects of valerian are similar to those of benzodiazepine (BZD), but the side effects are milder. Valerian influences the nerve receptors that regulate sleep, specifically the adenosine and serotonin receptors. A more recent systematic literature review (Fernandez-San-Martin et al., 2010), emphasizing well-designed studies and ignoring smaller or poorly designed clinical trials, concluded that valerian subjectively improved sleep quality; however, this was not demonstrated with objective measurements. Their study reported that although valerian is safe and has few side effects, its effectiveness in improving sleep quality required further clinical investigations.

### 1.2. The effect of acupressure on sleep

According to the theories of traditional Chinese medicine, the function of organs depends on the channels through which life energy flows. These channels are known as “meridians.” Meridians connect the internal with the external, transmitting *qi* (the life energy that is believed in traditional Chinese culture and medicine to sustain all living things) and blood to various organs, and enabling the body to function as a harmonious whole. Acupoints are points located along the meridians for infusing *qi*, reacting to pain or disease, and receiving treatment. Practitioners of acupressure use traditional Chinese medical theory to determine along which meridian, or in which organ, the disease has occurred. They then employ acupuncture to

locate the acupoints. Gentle pressure is manually applied (usually with the fingertips) to these acupoints to stimulate the flow of *qi* through the meridians and prevent/treat illness or disease (Ma, 2005; Hwang, 2004).

Ancient Chinese medical literature identified over 54 acupoints that are related to sleep disorders (Peng et al., 2007). Kim et al. (2004) reported that performing acupuncture on the Neiguan and Shenmen points improved the sleep conditions of people experiencing insomnia after a stroke. Tsay et al. (2003) applied acupressure to the Shenmen and Yongquan points of people with end-stage renal disease. Their results showed that acupressure can increase people's sleep quality and number of hours of sleep. Sun et al. (2005) and Xu et al. (2006) applied acupressure to the Yongquan and Shenmen points of nursing home residents. They found that applying acupressure to these points improved the residents' sleep quality. These studies showed that acupressure or acupuncture on the Shenmen, Yongquan, and Neiguan acupoints can improve sleep quality.

Acupressure and valerian aromatherapy are complementary non-invasive therapies. However, no data exists regarding how effective the combined application of these therapeutic methods are to improving the sleep quality of critically ill patients. Considering the critically ill status of the participants, we conducted this clinical trial by applying acupressure with valerian oil, instead of acupuncture, on the Neiguan, Shenmen, and Yongquan acupoints. This study investigates the effectiveness of valerian acupressure on the sleep quality of ICU patients.

## 2. Materials and methods

### 2.1. Research design and location

This study adopted a randomized experimental design, which was approved by the Ethical Review Committee of the study location (Code: 96-08-14A). We recruited subjects from the ICU of a medical center in Taipei during 2009. This ICU had 28 single-bed rooms and a 24-bed ward, for a total of 42 beds. The annual bed occupancy rate was 92%. Nursing staff operated in three shifts; the nurse-to-patient ratio was 1:2. Nighttime visiting hours were 6:00 pm to 7:00 pm. From 10:00 pm to 6:00 am, the ceiling lights in the patients' rooms were turned off and the bedside light and wall light were left on. However, the hallway lights and workstation lights were maintained at daytime brightness levels.

### 2.2. Sampling and number of samples

The study participants were patients who were conscious, literate, communicable, and had agreed to participate. Considering the physical vitality and frequency of treatment, we decided to include patients with an acute physiology score (APS, part of APACHE II) of lower than 15, that is, stable and less critical ICU patients. Patients were excluded from this study if they were hand or foot amputees, diagnosed with bilateral paralysis or convulsions, sedative users, or had been consuming sleeping pills for over a month.

After the participants signed consent forms, demographic and clinical data were collected. The participants were then divided into groups by randomly selecting a numbered (1–10) stick from a bin. Participants who had selected odd numbers were assigned to the control group, and the participants who had drawn even numbers were assigned to the experimental group. G-power (Faul et al., 2007) was used to estimate sample size prior to the data collection. Since the testing hypothesis was that the experimental group would sleep better than the control group, we set the difference in sleep hours as the primary outcome and chose the independent *t*-test in G power to estimate the sample size. This study was powered to detect a difference of 60 min in sleep, based on an estimated standard deviation of 75 min, referred to the studies of Tsay et al. (2003) and Kim et al. (2004). We set  $\alpha = .05$  for two-sided independent *t*-test with an effect size of 0.8, the estimated sample size for each group is 26 for a power of 80%, and was 34 for a power of 90%. We decided to enroll at least 40 in each group.

### 2.3. Intervention

Based on the results of the literature review, we applied 2.5% valerian essential oils to the participants' Neiguan, Shenmen (both located near the inner side of the wrist), and Yongquan points (located on the foot), before administering acupressure between 7:00 pm and 10:00 pm. Acupressure was performed by researchers who had attended acupressure training courses. Prior to delivering acupressure, these researchers located the Shenmen, Neiguan, and Yongquan points on 10 patients in three licensed traditional Chinese medicine clinics and had professional practitioners of Chinese medicine ensure that the researchers had located these points with 100% accuracy.

At the second night after enrollment, we performed valerian acupressure on the participants' Neiguan, Shenmen, and Yongquan points. The thumb was used to apply pressure to the acupoints at a 90° vertical angle. Pressure was applied for 5 s and then released for 1 s. The pressure began light and was progressively increased to 3–5 kg until the participants indicated that they felt pain, numbness, or swelling. Pressure was continuously applied to each acupoint for 3 min (Ma, 2005; Xu et al., 2006). The total time for one intervention on the 6 acupoints was 18 min.

Before performing acupressure, the researchers employed a scale to assess the degree of pressure applied by requesting colleagues observe the pressure for 10 s. This was to ensure that the pressure was maintained within a 3–5 kg range.

### 2.4. Measurement

#### 2.4.1. Sleep time and quality

Sleep is a complex physiological and behavioral process that cannot be analyzed by a single examination or piece of equipment. Objective methods of measuring sleep include a polysomnography (PSG), actigraphy, and sleep observation. A PSG must be performed in a laboratory. However, because critically ill patients are connected to numerous

machines that monitor their vital signs, conducting a PSG on these patients is impossible. An actigraphy (which involves fastening watch-like bands around the person's wrists or ankles) and sleep observations by nursing staff are currently the most suitable methods for objectively assessing the sleep quality of critically ill patients (Beecroft et al., 2008).

Subjective sleep assessments refer to person's own evaluation of their sleep and involve sleep diaries, a visual analog scale, the Pittsburg Sleep Quality Index, and the Stanford Sleepiness Scale (SSS). These methods are suitable for patients who can clearly describe their sleep conditions (Richardson et al., 2007). Critically ill patients who depend on medical equipment for survival cannot focus on numerous questions regarding their sleep. Therefore, scales that are easily understood and require minimal effort to complete, such as the Stanford Sleepiness Scale, are more appropriate for subjective sleep assessments by seriously ill patients.

#### 2.4.2. ActiGraph GT1M monitor

This study used the ActiGraph GT1M activity monitor (manufactured by ActiGraph, LLC, U.S.) as a sleep measurement tool. Patients selected whether they wore the monitor on their hand or foot. This device recorded the patient's state of sleepiness/wakefulness according to changes in their level of muscular activity. When the monitoring was complete and the patient had removed the device, ActiWeb software was used to store the data on a computer. This data detailed each patient's daily hours of sleep, time spent awake, and waking frequency (Beecroft et al., 2008).

#### 2.4.3. Nursing activity and sleep observation checklists

All nursing activities that could occur between 10:00 pm to 6:00 am were listed based on the general work routines in hospital wards and literature references. This list was then divided into hourly intervals. Nursing staff recorded the frequency of nursing activities for every hour from 10:00 pm to 6:00 am.

Before beginning this study, 10 night nurses were recruited to act as sleep observers. A meeting was held to explain this task to the sleep observers. That is, they were to observe patients' eye and body movements for at least 5 min every hour. If they believed the patient was in a state of sleep, they indicated this by marking 1 on the checklist. If they believed that the patient was awake, they recorded this by marking 2. When the observers were unsure of the wakefulness of the patient, they marked 3. After the explanation session, two observers jointly observed one patient during sleep and compared their observation results. When the results were consistent three consecutive times, the staff members were included as sleep observers in this study.

#### 2.4.4. Stanford Sleepiness Scale (SSS)

This study used the SSS, modified by Fichten et al. in 1995, to collect data of the subjective feelings of each patient regarding sleep quality. The SSS comprises seven levels, with Level 1 the highest level of wakefulness and Level 7 the highest level of sleepiness. The SSS is one of the

scales currently used by the Bureau of National Health Insurance in Taiwan to measure excessive daytime sleepiness when prescribing modafinil for the treatment of narcolepsy (Bureau of National Health Insurance, 2010).

## 2.5. Relaxation response

### 2.5.1. Heart rate variability

Recent studies support the correlation between cardiovascular regulation and relaxation. To evaluate the immediate effect of valerian acupuncture on promoting sleep, we also included heart rate variability (HRV) measures. The HRV analyzer adopted in this study was portable (DailyCare BioMedical, Chungli, Taiwan). Using analysis software, the HRV analyzer reads heart rate from the forearm and records the data through an EKG lead I. The HRV analyzer used in this study was assessed using rigorous electromagnetic interference and compatibility tests and approved by the Conformite Europeenne (CE). Additionally, the HRV analyzer has been used in clinical studies on HR variability (Lee et al., 2011; Peng et al., 2009; Wen et al., 2007).

To measure HR, the researchers placed the sensor on the radial area of the patient's forearm for 5 min before and after the intervention. Because time domain analysis is optimal for long-term EKG recordings (Chiu et al., 2003), we adopted frequency-domain analysis in this study. In frequency-domain analysis, total power represents the overall activity of the autonomic nervous system (ANS). Low frequencies (LFs; frequencies between 0.04 and 0.15 Hz) reflect mixed sympathetic and parasympathetic activities. High frequencies (HFs; frequencies between 0.15 and 0.4 Hz) reflect parasympathetic activity. High values of the low-to-high (LF/HF) ratio indicate a dominance of sympathetic activity, whereas low values indicate a dominance of parasympathetic activity (Lee et al., 2011).

### 2.5.2. Data collection process

Before 10:00 pm of the first day following enrollment, researchers attached the actigraphy monitors to the participants' hands or feet in a manner that would not affect the attached medical apparatus. Monitoring using the ActiGraph was continued until the morning of the third day.

On the first and second night after enrollment, the frequency of nursing activities performed every hour between 10:00 pm and 6:00 am was recorded on the nursing activity checklist by the nurses caring for the patients. The trained sleep observers recorded information on the sleep observation checklists.

On the second and third day between 7:00 am and 8:00 am, the day shift nurses asked the patients to select the SSS level that most closely described their current state. Each level of the scale was read aloud to the patients, who indicated their answer by writing or nodding.

Intervention was performed during the evening of the second day. Participants of the experimental group underwent valerian acupuncture between 7:00 pm and 10:00 pm. They also received heart rate measures for 5 min before and after intervention. The control group was only provided regular care.

The data collection and intervention process is shown in Fig. 1.

### 2.5.3. Data processing and analysis

The SPSS 12.0 software package was used for data analysis. Frequency, percentages, and standard deviation were used to present the data for each variable. A chi-squared test and an independent samples *t*-test was used to compare the demographic and clinical information of the two groups. The paired *t*-test was conducted to compare the differing objective/subjective sleep measurements between the two groups. Pearson's correlation was employed to examine the correlation between variables. A *p*-value of  $<.05$  was considered statistically significant.

## 3. Results

### 3.1. Participant information

This study enrolled 85 participants, with 41 in the experimental group and 44 in the control group. The demographic and clinical data of the participants are shown in Table 1. Both groups contained more male than female participants. Additionally, more participants in the control group were staying in single rooms compared to the participants in the experimental group. The mean age and mean APS scores for the experimental group were higher than those for the control group. The results of the chi-squared and independent sample *t*-tests showed that no statistically significant differences existed between the two groups regarding gender, age, disease type, room type, and frequency of nursing activities. However, a significant difference existed between the APS of the two groups. The mean APS scores of the experimental group were higher than those of the control group ( $13 \pm 2.9$  versus  $11.1 \pm 3.5$ ,  $p < .05$ ).

### 3.2. Sleep conditions of the participants

The sleep conditions of the participants in each group are shown in Table 2. The two groups did not show any statistically significant differences in their observed sleep and sleep measurements on the first night. However, the experimental group reported statistically significant lower SSS ratings compared to that of the control group (Table 2). On the second night, the difference in the number of hours of sleep and number of uncertain hours observed between the two groups was statistically significant. The experimental group had more sleep hours ( $3.4 \pm 1.7$  versus  $2.6 \pm 1.5$ ,  $p = .03$  by observation, and  $7.8 \pm 0.3$  versus  $7.1 \pm 1.4$ ,  $p < .001$  by actigraphy), less waking minutes ( $14.2 \pm 17.0$  versus  $54.6 \pm 86.1$ ,  $p < .001$  by actigraphy), less waking frequency ( $2.3 \pm 2.8$  versus  $6.3 \pm 8.2$ ,  $p < .001$  by actigraphy), and lower SSS ratings ( $2.5 \pm 0.5$  versus  $3.4 \pm 1.1$ ,  $p < .001$ ) compared to the control group.

A comparison of the sleep measurements for the control group on the first and second nights revealed that the only significant change was an increase in waking frequency ( $4.3 \pm 4.4$  versus  $6.3 \pm 8.2$ ,  $p = .048$ ) measured by the ActiGraph. However, the changes in sleep and SSS ratings did not reach a statistically significant level.

By contrast, a comparison of the sleep measurements for the experimental group on the first and second nights revealed statistically significant differences following the valerian acupuncture intervention. The patients' observed

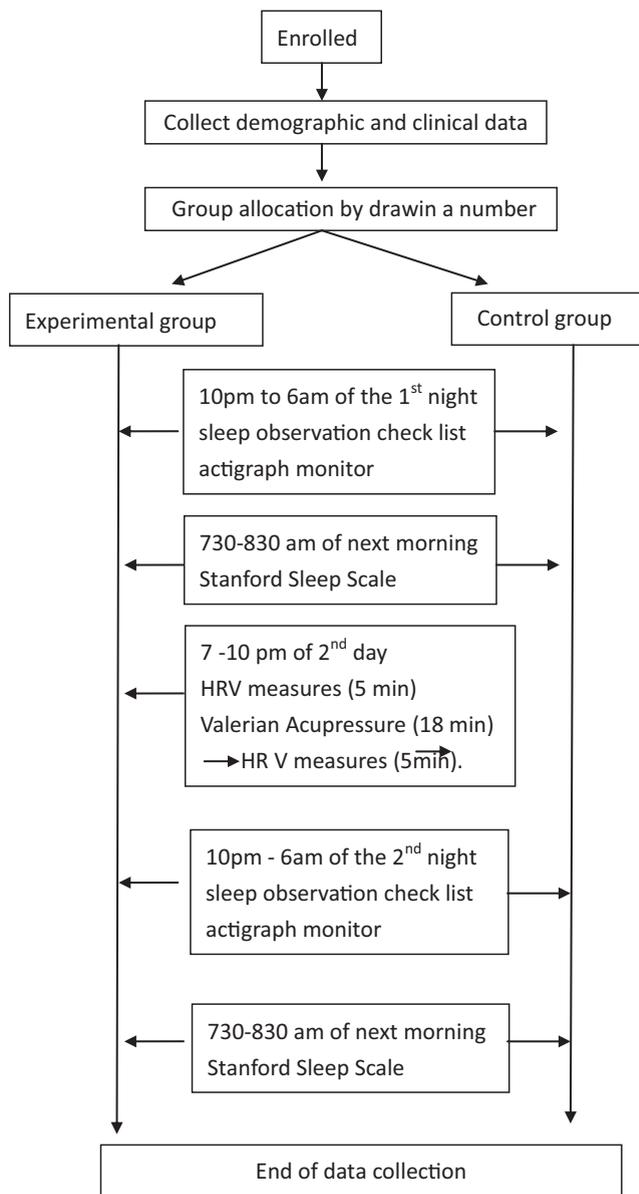


Fig. 1. Data collection and intervention process.

number of sleep hours increased ( $2.3 \pm 1.6$  versus  $3.4 \pm 1.7$ ,  $p < .001$ ) and their hours spent awake decreased ( $5.2 \pm 1.7$  versus  $4.3 \pm 1.7$ ,  $p = .01$ ). The actigraphy measurements also showed an increase in sleep hours ( $7.3 \pm 1.3$  versus  $7.8 \pm 0.3$ ,  $p = .01$ ) and a reduction in waking minutes ( $45.1 \pm 85.2$  versus  $14.2 \pm 17.0$ ,  $p = .01$ ) and waking frequency ( $4.6 \pm 6.2$  versus  $2.3 \pm 2.8$ ,  $p = .02$ ). A statistically significant reduction in SSS ratings also occurred ( $2.9 \pm 0.7$  versus  $2.5 \pm 0.5$ ,  $p = .03$ ).

### 3.3. The HRV parameters before and after valerian acupressure

The frequency-domain parameters of HRV before and after valerian acupressure for the experimental group are shown in Table 3. Although the total power increased, the

increase was not statistically significant. The results show that the low frequency significantly decreased and the high frequency significantly increased. Additionally, the LF/HF ratio decreased from  $1.5 \pm 1.7$  to  $0.6 \pm 0.5$  ( $p < .01$ ), indicating the relaxation responses of the participants after undergoing valerian acupressure.

### 3.4. Factors that influenced sleep quality

Pearson's correlation was used to examine the correlations among age, severity of illness, frequency of nursing activity, observed number of hours of sleep, number of hours spent awake at night, waking frequency, total amount of time spent sleeping, and SSS ratings. The results showed that the APS scores and waking frequency were significantly negatively correlated ( $r = -0.25$ ,

**Table 1**  
Demographic and clinical data of the subjects.

	Experimental group (n = 41)		Control group (n = 44)		p <sup>a</sup>
	N	(%)	N	(%)	
Gender					
Male	30	(73.2)	35	(79.5)	.33
Female	11	(26.8)	9	(20.5)	
Single-bed room					
Yes	17	(41.5)	24	(54.5)	.09
No	24	(58.5)	20	(45.5)	
	Experimental group (n = 41)		Control group (n = 44)		p <sup>b</sup>
	Mean	(SD)	Mean	(SD)	
Age	72.1	(18.2)	69.1	(15.1)	.25
APS score	13	(2.9)	11.1	(3.5)	<.01*
No. of nursing activity	21.5	(4.9)	20.6	(4.9)	.22

<sup>a</sup> Examined by Chi-squared test.<sup>b</sup> Examined by independent *t*-test.\* *p* < .05.

*p* < .05). However, no other significant correlations existed between the variables described previously.

#### 4. Discussion

##### 4.1. The influence of valerian acupressure on sleep

In this study, the total amount of time patients' spent sleeping, time spent awake, and waking frequency were

similar between the two groups before administering the valerian acupressure intervention (Table 2). In the control group, waking frequency significantly increased on the second night, indicating that the ICU patients experienced persistent sleep disruption. However, after the valerian acupressure intervention, patients in the experimental group spent more time sleeping and woke less frequently compared to patients in the control group, suggesting an

**Table 2**  
Comparison of sleep conditions between the two groups.

	Experimental (n = 41)		Control (n = 44)		p <sup>a</sup>
	M	(SD)	M	(SD)	
Sleep hours by observation					
Hours of sleep					
1st night	2.3	(1.6)	2.8	(1.9)	.26
2nd night	3.4	(1.7)	2.6	(1.5)	.03 <sup>†</sup>
<i>p</i>	<.001*	.62			
Hours spent awake					
1st night	5.2	(1.7)	4.7	(1.9)	.23
2nd night	4.3	(1.7)	4.6	(1.8)	.51
<i>p</i>	.01 <sup>†</sup>	.52			
Uncertain hours					
1st night	0.5	(0.8)	0.5	(0.7)	.82
2nd night	0.3	(0.7)	0.8	(1.5)	.04 <sup>†</sup>
<i>p</i>	.27	.19			
Sleep hours by actigraphy					
Hours of sleep					
1st night	7.3	(1.3)	7.3	(1.2)	.99
2nd night	7.8	(0.3)	7.1	(1.4)	<.001*
<i>p</i>	.01 <sup>†</sup>	.55			
Minutes spent awake					
1st night	45.1	(82.5)	45.3	(72.7)	.99
2nd night	14.2	(17.0)	54.6	(86.1)	<.001*
<i>p</i>	.01 <sup>†</sup>	.99			
Waking frequency					
1st night	4.6	(6.2)	4.3	(4.4)	.84
2nd night	2.3	(2.8)	6.3	(8.2)	<.001*
<i>p</i>	.02 <sup>†</sup>	.048 <sup>†</sup>			
Stanford Sleepiness Scale					
1st night	2.9	(0.7)	3.7	(1.2)	<.001*
2nd night	2.5	(0.5)	3.4	(1.1)	<.001*
<i>p</i> <sup>b</sup>	.03 <sup>†</sup>	.18			

<sup>a</sup> Examined by independent *t* test.<sup>b</sup> Examined by paired *t* test.\* *p* < .05.

**Table 3**  
The HRV parameters before and after valerian acupressure ( $N = 41$ ).

	Before		After		<i>p</i>
	Mean	(SD)	Mean	(SD)	
Total power	2227.0	(3527.1)	3917.7	(10331.3)	.21
%LF	48.2	(21.2)	35.6	(15.9)	.001*
%HF	51.7	(21.4)	64.2	(16.5)	.002*
LF/HF	1.5	(1.7)	0.6	(0.5)	<.001*

Examined by paired *t* test.

improvement in sleep quality. These findings show that valerian acupressure positively influences the sleep quality of ICU patients.

The sleep promoting effect may also elicit a relaxation response immediately after the valerian acupressure is applied. Our data indicated that this relaxation response can be measured using 5-min HR variability. However, whether the relaxation and sleep improvement effects of the valerian acupressure among ICU patients were the result of the acupressure or valerian oil requires further investigation.

#### 4.2. Measurement of the sleep quality among critically ill patients

In this study, sleep measurements and the sleep observations results were inconsistent. Two possible reasons for this exist; one is that the sleep observers monitored patients' sleep for only 5 min every hour, resulting in a total of 2–3 h observation. A 5-min observation has a limited ability to represent sleep for the entire hour. Reducing the intervals between observations to 15–30 min may facilitate a closer observation of the patients' sleep conditions. The second reason is that the actigraphy measurements recorded the frequency and kinetic energy of physical activity to determine whether the patient was asleep or awake. Because critically ill patients require continuous monitoring by machines and depend on medical equipment for survival, they reduce their movements when awake to avoid disturbing the tubes, wires, and other apparatus connecting them to medical machines. Even when awake, they may continue to lie quietly on their beds, which may cause a discrepancy between the sleep measurements and sleep observation results. In other words, the ActiGraph measurement may overestimate the sleep status of ICU patients.

Beecroft et al. (2008) applied both a PSG and the activity recorder on critically ill patients and compared the results. They found that critically ill patients have low activity levels, which caused a discrepancy between the results of using muscle activity to differentiate between states of wakefulness, and the PSG measurement. We assumed that patients with APS scores lower than 15 were stable enough to mobilize their limbs for ActiGraph monitoring; however, our assumption was obviously wrong. Therefore, a more sensitive device is required when using muscle activity monitoring to evaluate the sleep-awake status of ICU patients. This study addressed this discrepancy by comparing two measures and used the increase or decrease to reflect the difference between two groups.

Therefore, the ActiGraph measurements were retained to provide information for reference.

Considering the debilitating conditions and severe illnesses of the critically ill patients, this study used the SSS to assess patients' drowsiness levels after waking in the morning. However, we did not assess patients' daytime drowsiness levels. The SSS ratings can be measured more frequently during the day to obtain more accurate data of subjective sleep assessments.

#### 5. Limitations and recommendations

This study contains measurement and instrument validity discrepancies. Additionally, the single measure of sleep observation and ActiGraph measures have some errors. Therefore, we used the difference between the two measures to evaluate the effect of the valerian acupressure intervention.

This study showed that valerian acupressure can improve the sleep quality of critically ill patients. Because valerian essential oils and acupressure are both beneficial to sleep, future research can test the effectiveness of each of these intervention measures on three groups to obtain further understanding of how valerian essential oils and acupressure influence the sleep of the critically ill patients.

#### 6. Conclusion

This results of this study support the hypothesis that valerian acupressure on the Shenmen, Neiguan, and Yongquan acupoints can improve ICU patients' sleep duration and quality. Relaxation responses experienced immediately after applying valerian acupressure can be observed using a HR variability analyzer. In critically ill patients experiencing sleep difficulties, performing acupressure on the Shenmen, Neiguan, and Yongquan acupoints can be an effective alternative, or reduce the use of, sedatives and promote better sleep quality.

#### Acknowledgement

This study was supported by the National Science Council of Taiwan, ROC (NSC 97-2314-B-715-004-MY3).

#### Conflicts of interest

None declared.

#### Funding

This study was supported by the National Science Council of Taiwan, ROC (NSC 97-2314-B-715-004-MY3).

#### Ethical approval

The human subject ethical review committee of the study site (Code: 96-08-14A).

#### References

- Beecroft, J.M., Ward, M., Younes, M., Crombach, S., Smith, O., Hanly, P.J., 2008. Sleep monitoring in the intensive care unit: comparison of nurse assessment, actigraphy and polysomnography. *Intensive Care Medicine* 34 (11), 2076–2083.

- Bent, S., Padula, A., Moore, D., Patterson, M., Mehling, W., 2006. Valerian for sleep: a systematic review and meta-analysis. *The American Journal of Medicine* 119, 1005–1012.
- Bureau of National Health Insurance, 2010. Regulations on Payment for Medications. <http://59.125.151.81/dyna/data/user/p0/files/201009241151040.pdf>.
- Celik, S., Oztekin, D., Akyolcu, N., Issever, H., 2005. Sleep disturbance: the patient care activities applied at the night shift in the intensive care unit. *Journal of Clinical Nursing* 14 (1), 102–106.
- Chiu, H.W., Lin, L.S., Kuo, M.C., Chiang, H.S., Hsu, C.Y., 2003. Using heart rate variability analysis to assess the effect of music therapy on anxiety reduction of patients. *Computers in Cardiology* 30, 469–472.
- Faul, F., Erdfelder, E., Lang, A.-G., Buchner, A., 2007. G\*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods* 39, 175–191.
- Fernandez-San-Martin, M.I., Masa-Font, R., Palacios-Soler, L., Sancho-Gomez, P., Calbo-Caldentey, C., Flores-Mateo, G., 2010. Effectiveness of valerian on insomnia: a meta-analysis of randomized placebo-controlled trials. *Sleep Medicine* 11 (June (6)), 505–511.
- Fichten, C.S., Creti, L., Amsel, R., Brender, W., Weinstein, N., Libman, E., 1995. Poor sleepers who do not complain of insomnia: myths and realities about psychological and lifestyle characteristics of older good and poor sleepers. *The Journal of Behavioral Medicine* 18 (2), 189–223.
- Hwang, J.L., 2004. *Atlas of Acupressure*. Sun Tsai Culture, Taipei.
- Kao, S.J., 1989. *Atlas of Chinese Herbs*. Taiwan Business Printing Inc., Taipei.
- Kim, Y.S., Lee, S.H., Jung, W.S., Park, S., Moon, U.K., Ko, S.K.C.N., et al., 2004. Intradermal acupuncture on Shen-Men and Nei-Kuan acupoints in patients with insomnia after stroke. *The American Journal of Chinese Medicine* 32 (5), 771–778.
- Lee, K.C., Chao, Y.H., Yiin, J.J., Chiang, P.I., Chao, Y.F., 2011. Effectiveness of different music-playing devices for reducing preoperative anxiety: a clinical control study. *International Journal of Nursing Studies* 48, 1180–1187.
- Ma, S.H., 2005. The clinical application of acupressure in nursing practice. *Nursing Magazine (Taiwan)* 52 (4), 5–10.
- Peng, S.-M., Koo, M., Yu, Z.-R., 2009. Effects of music and essential oil inhalation on cardiac autonomic balance in healthy individual. *Journal of Alternative and Complementary Medicine* 15 (1), 53–57.
- Peng, S.M., Cho, Y.T., Lai, R.N., Lee, P.S., Yeh, J.H., Cho, Y.C., Lin, Y.C., 2007. Acupuncture treatment for sleeping disturbance in ancient Chinese literature. *Medical Magazine of Taipei City* 4 (5), 1–12.
- Richards, K., Nagel, C., Markie, M., Elwell, J., Barone, C., 2003. Use of complementary and alternative therapies to promote sleep in critically ill patients. *Critical Care Nursing Clinics of North America* 15, 329–340.
- Richardson, A., Crow, W., Coghill, E., Turnock, C., 2007. A comparison of sleep assessment tools by nurses and patients in critical care. *Journal of Clinical Nursing* 16 (9), 1660–1668.
- Sun, C.L., Xu, W., Xu, H.Y., Chang, K.Y., Shieh, J.S., Chang, R.J., 2005. The effect of acupoints massage on improving insomnia problem of the nursing home residents. *Journal of Health Management (Taiwan)* 3 (2), 121–132.
- Taibi, D.M., Landis, C.A., Petry, H., Vitiello, M.V., 2007. A systematic review of valerian as a sleep aid: safe but not effective. *Sleep Medicine Reviews* 11, 209–230.
- Tamburri, L.M., DiBrienza, R., Zozula, R., Redeker, N.S., 2004. Nocturnal care interactions with patients in critical care units. *American Journal of Critical Care* 13 (2), 102–112.
- Tsay, S.L., Rong, J.R., Lin, P.F., 2003. Acupoint massage in improving the quality of sleep and quality of life in patients with end-stage renal disease. *Journal of Advanced Nursing* 42 (2), 134–142.
- Wen, T.L., Chung-K, W., Yang, I.F., Yang, T.F., 2007. Relationship electrolytes and heart rate variability parameters in end-stage renal failure patients before and after hemodialysis. *Anadolu Kardiyol Derg* 7 (1), 142–144.
- Xu, W., Xu, H.Y., Sun, C.L., 2006. The improving effect of Shenmen Acupressure on the insomnia problem of nursing home residents. *Evidence-Based Nursing (Taiwan)* 2 (4), 331–338.