Original Article

Effect of Acupressure on Pain and Sleep Quality of Patients with Cancer after Undergoing Surgery Admitted to the Intensive Care Unit: A Single-blind Randomized Clinical Trial

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Abstract

Background: Pain and sleep disturbances are among the most common symptoms and complications in cancer patients. This study aims to evaluate the effect of acupressure at the LI4 and SP6 points on pain and sleep quality in cancer patients after surgery. **Materials and Methods:** In this single-blind randomized clinical trial, cancer patients admitted to the intensive care unit at the Cancer Institute of Imam Khomeini Hospital in Tehran, Iran in 2022, following surgery, were divided into two equal groups of 39: an intervention group and a control group. On the second and third days after surgery, in the morning and evening, acupressure was applied bilaterally at the LI4 (hand) and SP6 (foot) points, in the experimental group. In the control group, surface touch was applied to the same points. Patients' pain was assessed using the visual analog scale of pain, and sleep quality was measured using the Richard-Campbell Sleep Questionnaire. Data were analyzed using the two-way repeated measures analysis of variance. **Results:** Statistical analysis showed that the interaction effect of group and time was statistically significant ($p < 0.001$), indicating that pain reduction was significantly greater in the experimental group compared to the control patients. A paired *t*-test demonstrated a significant increase in sleep quality after the acupressure intervention in the experimental group ($p < 0.001$), whereas no significant change was observed in the control group ($p = 0.124$). **Conclusions:** Acupressure was found to effectively reduce pain and improve sleep quality in cancer patients after surgery.

Keywords: *Acupressure, neoplasms, pain, sleep quality, surgery*

Introduction

Cancer is recognized as one of the leading causes of mortality and a major threat to life expectancy worldwide. In 2023, 1,958,310 new cases of cancer and 609,820 deaths due to cancer are anticipated in the United States.[1] According to a study conducted in Iran, 112,131 new cases of cancer were recorded in 2014.[2] Despite the increased incidence of cancer development, the number of survivors is also increasing due to advancements in the medical field and preventive measures. Cancer causes unpleasant physical and mental symptoms and complications in affected patients. Pain, depression, sleep disorders, and reduced sleep quality are among these complications and symptoms.[3] Cancers can be cured if detected early.

Pain and sleep disturbance are two of the most common symptoms. Cancer has numerous complications, with pain being the most important. Thousands of patients with cancer inside and outside of hospitals suffer from severe pain due to the disease; 20%–90% of all patients with cancer experience different pain levels. Cancer pain is caused due to various reasons, including the growth and spread of the tumor itself and complications of treatment methods such as chemotherapy, radiation therapy, surgery, and underlying diseases.[4] These symptoms can disrupt the patient's quality of life. Pain can affect sleep quality and lead to its reduction, even though there is evidence of a reciprocal relationship between these two complications.[5] In a review study in 2016, it was reported that 38% of patients with cancer experienced moderate-to-severe levels of pain. Steel *et al*.[6] reported that 59% of patients with cancer suffered from reduced sleep quality, and sleep shortage and reduced sleep time

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were associated with increased fatigue, pain, anxiety, depression, and decreased quality of life.

Sleep disturbance and reduced sleep quality are reported as negative factors affecting the quality of life of cancer patients. Sleeplessness and sleep problems are so severe in patients with cancer that they require treatment considerations. Sleeplessness causes symptoms such as fatigue, anxiety, and depression.[7] It also disrupts the body's immune system functioning and can lead to complications such as anxiety and depression. Sleep disturbance is one aspect of the disorder in an anxious individual. In 2016, 30%–75% of these patients experienced sleep disturbances related to dyspnea and fear of death.[8]

In terms of treatment and control of cancer-related symptoms and complications, drugs such as painkillers, nerve stimulants, and sedatives are used, although pharmacologic treatment can have new complications or lead to worsening some symptoms, for example, using opioids to relieve pain increases fatigue.[9] Painkillers have various complications on the body and mind of patients, including the risk of addiction, hypotension, poor vital functions, drowsiness, nausea, vomiting, shock, and high costs on the healthcare system. Drug therapy requires trained personnel and imposes high costs on patients. Drug shortage is another problem concerning economic issues.[6,7] Based on the World Health Organization statistics, 80% of the population of third-world countries lack access to basic drugs due to economic reasons. This leads patients to seek complementary and alternative treatments.[9]

One of these treatments is acupressure. Acupressure is a traditional Chinese medicine similar to acupuncture in which channels called meridians, which are responsible for the transfer of Qi energy, are used for treatment. Unlike acupuncture, acupressure does not have an invasive status and is performed only through fingers' pressure.[10,11] The functioning mechanism of acupressure is not clear yet, but studies have provided two theories as the functioning mechanisms of this treatment method: the "gate control theory" and the "biochemical mechanism theory." In the gate control theory, it is believed that pressure stimuli transfer impulses to the brain at four times the speed of pain impulses. These extended and fast impulses lead the neural gates to be closed and painful impulses that are slower to be blocked. In the biochemical theory, stimulating pressure points are said to cause releasing endorphins and serotonin.[12]

The benefits of acupressure include its cost-effectiveness, not being invasive, and not having complications. Furthermore, this treatment is easy to learn, and patients can do it by themselves.[9,13] It is worth mentioning that no interference between acupressure and other treatment methods has been observed so far, and acupressure can be used along with other treatments.[13] In a review study investigating the effects of acupressure and acupuncture on cancer pains, it was reported that using these two complementary treatment methods led to pain relief in patients with cancer and also reduced taking opioid painkillers in these patients.[14] The results of another review study dealing with the effect of stimulating pressure points on cancer patients' sleep indicate that stimulating these points can improve cancer patients' sleep and increase the quality of life of these individuals.[15]

Research has indicated that patients with cancer experience the most severe pain after surgery and during chemotherapy, and immediate measures must be taken after surgery.[4,6-8,10] Patients with cancer suffer from sleep quality disorders after treatment for a long time during the chemotherapy period because of the type of drugs and taking the drugs, which has been neglected by the experts and researchers, and no appropriate solution has been found for it. Moreover, considering the sources, acupressure has been shown to be one of the effective non-pharmacological treatments that can improve pain and sleep quality. This treatment, together with pharmacological treatments, can reduce both the complications of some drugs and the dependence and need for pharmacological treatments.[10]

Therefore, the current study was conducted to determine the effect of acupressure on pain levels and sleep quality of patients with cancer admitted to the intensive care unit (ICU) after surgery.

Materials and Methods

This randomized, single-blind clinical trial (IRCT20220111053686N1) was conducted at the Cancer Institute of Imam Khomeini Hospital Complex in Tehran, Iran, in 2022. After coordinating with the authorities of Imam Khomeini Hospital, the researcher visited the ICU ward of the Cancer Institute. After introducing herself and explaining the research objectives, she included cancer patients who met the inclusion criteria, obtaining written informed consent. Inclusion criteria included having at least 18 years of age, diagnosis of any type of cancer, having cancer surgery-related pain and reporting pain by the patient, not having cognitive and behavioral disorders (self-reported), having complete alertness, hearing and speaking ability, having no mental disorder, having no limb amputation, having no surgery or wound in pressure points, and having at least minimum literacy. Criteria such as the patient's death, the occurrence of a severe stressful event such as the death of one of the first-degree relatives, and unwillingness to continue cooperation, were also considered as exclusion criteria.

Based on the study of Khatiban *et al*.[16] in 2012 in Hamedan, and using Cochran's sample size formulae for comparing the means of two normally distributed independent samples and according to $\alpha = 0.05$ ($Z_{1-\alpha/2} = 1.96$), $\beta = 0.10$ ($Z_{1-\beta} = 1.29$), $\sigma_1 = 1.8344$ (standard deviation of changes in the total intensity score of fatigue in cancer patients

undergoing acupressure), $\sigma_2 = 1.3643$ (standard deviation of changes in the total intensity score of fatigue in cancer patients undergoing unreal acupressure), and taking into account the 10% dropout of patients after applying the exclusion criteria, the required sample size was 40 people in each group, and a total of 80 cancer patients undergoing chemotherapy were needed to conduct this study.

The patients meeting the inclusion criteria entered the study consecutively and then were assigned into two equal groups of experimental (n = 40) and control (n = 40) using permuted block randomization with size 4, which was generated by the CREATE A RANDOMISATION LIST computer program (https://www.sealedenvelope.com/simple-randomiser/v1/lists).Visual analog scale (VAS) was used to measure pain, and Richard-Campbell Sleep Questionnaire (RCSQ) was used to measure sleep quality. The visual scale of pain is a 10-cm ruler, with the word "no pain" written on the left side and the word "worst and most pain imaginable" written on the right end (0 = None, 1–3 = Mild, 4–6 = Moderate, 7–10 = severe). In a study in 2010, Missildine *et al*.[17] reported a moderate correlation between the RCSQ score and the nighttime sleep minutes. In 2018, its validity and reliability were confirmed. The correlation coefficient and Cronbach's alpha of the questionnaire were reported as 0.714 and 0.906, respectively.[18] In Hekmatpou *et al*.'s[19] study, it is reported that the reliability of VAS for pain in Iran, was confirmed with correlation coefficient 0.88. In Boonstra *et al*.'s[20] study, the Visual Analogue Scale (VAS) for pain demonstrated strong reliability and validity. The reliability was high with correlation coefficients ranging from 0.86 to 0.88.

Before the beginning of the intervention, the demographic questionnaire, the VAS, and the RCSQ were completed by the participants of both experimental and control groups. The acupressure intervention was performed on the second and third days after surgery (in two shifts, in the morning and evening) for the experimental group. In each group, the intervention was started after examining the patient's hemodynamic status and considering whether they received a painkiller or not, its type, and its dose. At the onset of the intervention, the desired points LI4 and SP6 were first identified. These points are the most important analgesic points in the body.[21] Acupressure was applied to the points in the hands and then the points in the feet bilaterally by thumb. The pressure applied to acupressure points was typically firm but gentle. Point LI4 is located between the thumb and index finger between the first and second metacarpal bones, and point SP6 is located four fingers above the foot's inner ankle bone behind the tibia bone. In the experimental group, points SP6 and LI4 were massaged bilaterally (on the second and third days after surgery) twice in the morning and evening in periods of 10 seconds of pressure and 2 seconds of rest for 8 minutes. This intervention was implemented by the researcher, who had taken acupressure courses, participated in training classes, and successfully received a valid certificate. The control group also received surface touch in periods of 10 seconds of gentle touch and 2 seconds of rest for 8 minutes on the second and third days after surgery (in two shifts, in the morning and evening). In this single-blind clinical trial, the patients were unaware that they were receiving the original or similar acupressure. The patients' pain was measured twice in the morning and in the evening on the desired days before and after each acupressure session by a VAS. Sleep quality was also completed before beginning the first round of intervention and the next morning after the last round of intervention using a face-to-face interview questionnaire in either group.

The independent two-sample *t*-test was used to compare the mean of quantitative variables across experimental and control groups. In addition, Chi-square or Fisher's exact tests were used to compare the frequency distribution of qualitative variables, as appropriate, across the two groups. The non-parametric Mann-Whitney U test was used to compare the median disease duration in the experimental and control groups. To compare the mean sleep quality score before and after the last round of intervention, paired *t*-test was used within each group under investigation. To compare the mean pain score during the intervention period (before the first intervention on the first day, after the first intervention on the first day, before the second intervention on the first day through after the second intervention on the second day) in the experimental and control groups, two-way repeated measures analysis of variance (ANOVA) was used and the group effect, the time effect, the group and time interaction effect were evaluated. The homogeneity of the covariance matrices in the experimental and control groups was evaluated by Box's M test, and no violation of this presumption was found (Box's M = 46.95, $p = 0.238$). The groups' equality of variance was also evaluated using Levene's test, and no violation of this assumption was observed ($p > 0.05$). The normality of the frequency distribution of the quantitative variables was evaluated by the non-parametric Kolmogorov-Smirnov test. For the statistical analyses, the statistical software SPSS version 22 (IBM, SPSS Inc, Chicago, IL, USA) was used. All *p* values were 2-tailed, with statistical significance defined by a *p* value equal to or less than 0.05.

Ethical considerations

This study was approved by the Ethics Committee of the Rajaie Cardiovascular Medical and Research Center (IR.RHC.REC1400.121). Written informed consent was obtained from the patients.

Results

Of the 80 patients who participated in the study, one patient from the experimental group was excluded due to transfer to the internal ward, and one patient from the control group was excluded due to re-intubation on the third

day post-surgery. Consequently, data of 78 patients were analyzed. Figure 1 shows the study's inclusion, allocation, and follow-up phases.

Out of 78 patients with cancer under investigation, 39 patients were in the experimental group (original acupressure), and 39 were in the control group (surface touch). Most of the patients in both groups were suffering from head and neck cancer, and others were suffering from gastrointestinal, urinary tract, or breast cancer.

In the experimental group, 20 (51.30%) were female, and 19 (48.70%) were male; in the control group, 16 (41%) were female, and 23 (59%) were male. The results showed no statistically significant difference in gender and mean age between the two groups ($p = 0.364$ and $p = 0.179$, respectively). Similarly, no statistically significant difference was found in the median disease duration between the two groups ($p = 0.829$). The demographic characteristics of patients in the experimental and control groups are shown in Table 1. Quantitative variables are presented as mean (SD) or median (1st quartile–3rd quartile), while qualitative variables are reported as numbers (percentages).

As seen in Table 1, no significant difference was found in the frequency distribution of marital status and occupation between experimental and control groups ($P > 0.05$). In addition, there was no significant difference in the frequency distribution of education level, place of residence, history of smoking or alcohol use, and history of drug use between the two groups ($p > 0.05$). The frequency distribution of characteristics related to the disease in experimental and control patients is presented in Table 2.

As seen in Table 2, Fisher's exact test did not indicate a statistically significant difference in the frequency distribution of the characteristics related to the disease between the patients in the experimental and control groups ($p > 0.05$).

Table 3 compares the mean pain score during the intervention period according to the investigated groups. As seen in Table 3 and Figure 2, the two-way repeated measures ANOVA revealed that the group effect was statistically significant ($p < 0.001$), meaning that the total mean pain score over the entire time period was significantly lower in the experimental group than in the control group. The statistical analysis also revealed that the time effect was statistically significant ($p < 0.001$), meaning that the mean pain score decreased significantly during the intervention period over the two groups as a whole. The statistical analysis also showed that the group and time interaction effect was statistically significant ($p < 0.001$), meaning that the slope of the mean pain score reduction during the intervention period was significantly sharper in the experimental group than in the control group. In other words, the original acupressure intervention was significantly effective in reducing the pain score of patients with cancer after surgery compared to the gentle touch.

In Table 4, the mean sleep quality score before and after the acupressure intervention in patients with cancer after

Table 1: Demographic characteristics of patients with cancer after surgery according to the studied groups

Group Variable	Experimental (n=39) n (%)	Control (n=39) n (%)	Test statistic	Degree of freedom	p
Marital Status			-	-	0.358*
Single	4 (10.30)	1 (2.60)			
Married	35 (89.70)	38 (97.40)			
Occupation			-	-	0.672*
Employee	3 (7.70)	5 (12.80)			
Self-employed	12 (30.80)	9 (23.10)			
Housewife	17 (43.60)	15 (38.50)			
Retired	5 (12.80)	9 (23.10)			
Unemployed	2 (5.10)	1 (2.60)			
Education level			1.66	3	0.646**
Illiterate	11 (28.20)	11 (28.20)			
Under diploma	11 (28.20)	12 (30.80)			
Diploma	8 (20.50)	11 (28.20)			
Bachelor and higher	9 (23.10)	5 (12.80)			
Place of residence			1.91	1	0.167**
Tehran	13 (33.30)	19 (48.70)			
Outside of Tehran	26 (66.70)	20 (51.30)			
History of alcohol or cigarette use	11 (28.20)	12 (30.80)	0.06	1	0.804**
History of drug use	10 (25.60)	6 (15.40)	1.26	1	0.262**

*p derived from Fisher's exact test. **p derived from Chi-square test

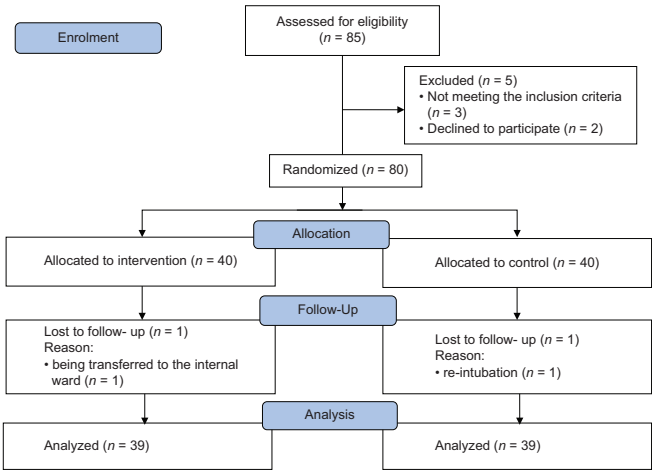

Figure 1: The flowchart of the study's inclusion, allocation, and follow-up phases

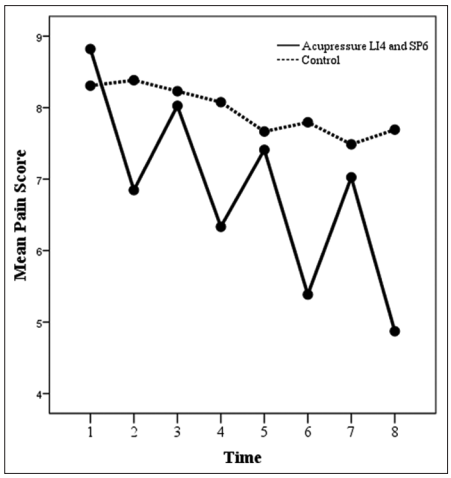

Figure 2: The mean pain score of patients with cancer after surgery in the experimental and control groups over the intervention period

Table 2: Comparing the disease characteristics in patients with cancer after surgery in terms of the two groups

Group Variable	Experimental (*n*=39) *n* (%)	Control (*n*=39) *n* (%)	Test Statistic	Degree of freedom	*p**
Cancer type			-	-	0.812
Head and neck cancer	21 (53.80)	19 (48.70)			
Gastrointestinal cancer	14 (35.90)	13 (33.30)			
Urinary tract cancer	1 (2.60)	1 (2.60)			
Breast	0	2 (5.10)			
Other	3 (7.70)	4 (10.30)			
Disease phase			-	-	0.215
Phase 2	10 (25.60)	7 (17.90)			
Phase 3	29 (74.40)	29 (74.40)			
Phase 4	0	3 (7.70)			
Underlying disease	22 (56.40)	13 (33.30)	-	-	0.242
No disease	5 (12.80)	5 (12.80)			
Hypertension	2 (5.10)	5 (12.80)			
Diabetes	3 (7.70)	3 (7.70)			
Other	7 (17.90)	13 (33.30)			
More than one disease					
Receiving painkiller on the second day			-	-	0.999
No	1 (2.60)	2 (5.10)			
Morphine	34 (87.20)	34 (87.20)			
Methadone	4 (10.30)	3 (7.70)			
Receiving painkiller on the third day			-	-	0.548
No	0	2 (5.10)			
Morphine	35 (89.70)	34 (87.20)			
Methadone	4 (10.30)	3 (7.70)			

*p derived from Fisher's exact test

surgery is compared across the two groups. The independent two-sample t-test indicated that the mean sleep quality score before the intervention did not show a significant difference ($p = 0.315$), while after the intervention, it was significantly higher in the experimental group than in the control group ($p < 0.001$). In addition, the mean increase in the sleep quality score was significantly higher in the experimental group than in the control group ($p < 0.001$).

The paired t-test showed that in the experimental group, the mean sleep quality score increased significantly ($p < 0.001$) after acupressure intervention, while this increase was not significant in the control group ($p = 0.124$).

Table 3: Mean and standard deviation of pain score in the experimental and control groups and intragroup and intergroup effects in patients with cancer after surgery

Group Time	Experimental (*n*=39) Mean (SD)	Control (*n*=39) Mean (SD)	Group effect	Time effect	Group and time interaction effect
1- Before the first intervention on the first day	8.82 (0.79)	8.31 (0.66)	*F*=89.33	*F*=157.21	*F*=98.39
2- After the first intervention on the first day	6.85 (0.84)	8.38 (0.67)	df=1	df=7	df=7
3- Before the second intervention on the first day	8.03 (0.78)	8.23 (0.71)	*p*<0.001	*p*<0.001	*p*<0.001
4- After the second intervention on the first day	6.33 (0.90)	8.08 (0.77)			
5- Before the first intervention on the second day	7.41 (0.64)	7.67 (0.66)			
6- After the first intervention on the second day	5.38 (0.75)	7.79 (0.73)			
7- Before the second intervention on the second day	7.03 (0.58)	7.49 (0.56)			
8- After the second intervention on the second day	4.87 (0.66)	7.69 (0.69)			

SD; Standard deviation

Table 4: Comparing the mean sleep scores before and after the acupressure intervention in patients with cancer after surgery in terms of the investigated groups

Group Time	Experimental (*n*=39) Mean (SD)	Control (*n*=39) Mean (SD)	Test statistic	Degree of freedom	*p**
Before intervention	20.82 (4.85)	21.95 (5.01)	-1.01	76	0.315
Next morning after the last round of intervention	33.00 (4.17)	22.67 (5.30)	9.56	76	<0.001
Changes (before and after intervention)	12.18 (4.05)	0.72 (2.85)	14.46	68.17	<0.001
Test statistical index value	-18.77	-1.58	-	-	-
Degree of freedom	38	38			
P**	<0.001	0.124			

**p* derived from independent two-sample *t*-test. ***p* derived from paired *t*-test.

Discussion

This study aimed to determine the effect of acupressure in points LI4 and SP6 on pain levels and sleep quality of patients with cancer after surgery. In this study, no statistically significant difference was observed between the patients' demographic characteristics and the disease characteristics in the experimental and control groups; therefore, the two groups under investigation were similar following randomization.

In the current study, the total mean pain score was significantly lower in the experimental group than in the control group. Acupressure on the LI4 and SP6 points appears to reduce patients' pain levels. In the study by Bastani *et al.*[21] on women with multiple sclerosis, the patients were trained to perform acupressure on points ST36, LI4, and SP6 for 2 weeks, and touching these points was also taught in the control group. The results indicated that 2 and 4 weeks after acupressure, the pain severity decreased immediately in the intervention group compared to the control group, which is consistent with the results of the present study.[21] In Serçe *et al.*'s[22] study on patients with cancer with bone metastasis, eight acupressure sessions (with heating and acupressure periods) were implemented in the intervention group, and the control group received no intervention. The results showed that the mean pain score reduced in the intervention group after acupressure. Therefore, acupressure may make a difference in patients' pain relief. The results of this study align with the current research.

In Shahdadi *et al.*'s[23] study on diabetic patients, acupressure was performed on 40 patients referred to the diabetes clinic at point HT7 (Shen Men). Petersburg Sleep Quality Questionnaire was completed by the subjects before and after acupressure. The results of investigating sleep quality revealed that acupressure at point HT7 could improve sleep quality in diabetic patients. Considering the positive effect of acupressure in improving patients' sleep quality, the results of this study are consistent with the present research. In addition, in Neri *et al.*'s[24] study on pregnant women with poor sleep quality and severe anxiety symptoms, acupressure was performed at point HT7, and it was found that in the experimental group, acupressure at point HT7 improved sleep quality and reduced anxiety in pregnant women in the third trimester of pregnancy during 2 weeks, but this result was unclear in the long run. The result of this study is consistent with the present research in terms of the positive effect of acupressure on sleep quality.

Limitations include not assessing other factors influencing sleep quality and not differentiating patients based on cancer type.

Conclusion

The results of this study demonstrate that acupressure significantly alleviates pain and improves sleep quality in post-surgery cancer patients. Therefore, it is recommended

to use acupressure interventions alongside routine treatments to alleviate pain and improve sleep quality in these patients.

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Conflicts of interest

There are no conflicts of interest.

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