Acta Anaesthesiol Taiwan 2010;48(2):80–86

ELSEVIER

ORIGINAL ARTICLE

Effects of Auricular Acupressure on Pain Reduction in Patient-controlled Analgesia After Lumbar Spine Surgery

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Received: May 18, 2009
Revised: Feb 5, 2010
Accepted: Feb 10, 2010

KEY WORDS:
auricular acupressure;
pain;
postoperative nausea and vomiting;
satisfaction

Objective: This study aimed to examine the adjuvant effects of auricular acupressure in augmenting intravenous patient-controlled analgesia with morphine and droperidol for postoperative lumbar surgery patients in terms of postoperative pain relief satisfaction, and the incidence of postoperative nausea and vomiting (PONV).
Methods: In this single-blind experimental study, 94 subjects were randomly assigned to the experimental group in which patients received auricular acupressure to six auricular acupoints or a control group without acupressure. Data were collected using the American Pain Society Patient Outcome Questionnaire. Descriptive analyses, *t* tests, χ^2 tests, Mann-Whitney tests, and the generalized estimating equation model were used.
Results: The experimental group had lower average pain scores than the control group, but no between-group difference was found. Analgesic dose and satisfaction were similar in both groups. The incidence of PONV was low and similar in both groups.
Conclusion: Although this study did not demonstrate adjuvant effects of auricular acupressure on postoperative pain, analgesic dose, analgesic satisfaction and PONV, most subjects were satisfied with the pain management even though they were subjected to moderate pain because of insufficient analgesia. Further studies should reconfirm the effects of auricular acupressure on analgesia provided by intravenous patient-controlled analgesia in postoperative patients, and its influence on the frequency and duration of analgesia administration.

1. Introduction

Postoperative wound pain is ranked as the foremost postoperative problem, particularly in orthopedic surgery, with 53.9% of patients reporting this problem.[1] Furthermore, increased postoperative pain is associated with greater postoperative bleeding.[2] Moreover, the patient's emotional state is seriously disturbed and the length of hospital stay is prolonged by postoperative pain.[3–5] Patient-controlled analgesia (PCA) is an important method of treating severe postoperative pain, because it provides a higher degree of satisfaction with pain relief.[6,7] However, the incidence of postoperative nausea and

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vomiting (PONV) with opioid PCA ranges from 59% to 70%.[8,9] Although PCA has significant analgesic effects, dissatisfaction with the analgesia is primarily due to PONV induced by morphine,[10,11] which may lead to aspiration, dehydration and electrolyte imbalance, for example,[12] and thus increased medical costs.[13] PONV is usually treated by antiemetics;[14] however, for patients at high risk of PONV, this treatment does not always work.[15] Thus, providing surgical patients with an effective means to alleviate pain, while avoiding PONV, is particularly important.

Acupressure is the application of pressure to the sites used for acupuncture (acupoints). The stimulating acupoints can adjust organs, rectify *qi*, stabilize the body, strengthen functions, and cure diseases.[16–18] Acupressure stimulates the release of endogenous opioids by the body[19,20] and can be blocked in a dose-dependent manner by naloxone, an opioid antagonist.[21] Although there are restrictions on the use of this technique,[22] clinical studies have demonstrated the effects of acupoint stimulation on postoperative pain[23–25] and PONV.[26] However, using auricular acupoints to reduce postoperative pain is promising but not compelling based on a systematic review.[27] The use of auricular acupressure combined with PCA to alleviate postoperative pain and reduce PONV needs examination and testing. Therefore, this study examined the adjuvant effects of auricular acupressure in augmenting PCA used for postoperative lumbar surgery patients in terms of pain relief, satisfaction and preventing PONV.

2. Methods

This was a single-blind experimental study. Lumbar surgical patients were recruited from an orthopedic ward in a 2909-bed medical center. A randomization list was used to randomly divide subjects into the experimental group, in which auricular acupressure was given in addition to regular care, and the control group, in which only regular care was given. All subjects involved in the study were blinded to the study. According to the criteria,[28] to detect a medium effect size ($f=0.3$) and three-time repetition for morphine consumption, a sample size of 62 would be required to achieve a 5% probability of type I error at 80% power. Considering loss to follow-up, 94 subjects were deemed necessary (Figure 1). The inclusion criteria were age = 18 years, surgical

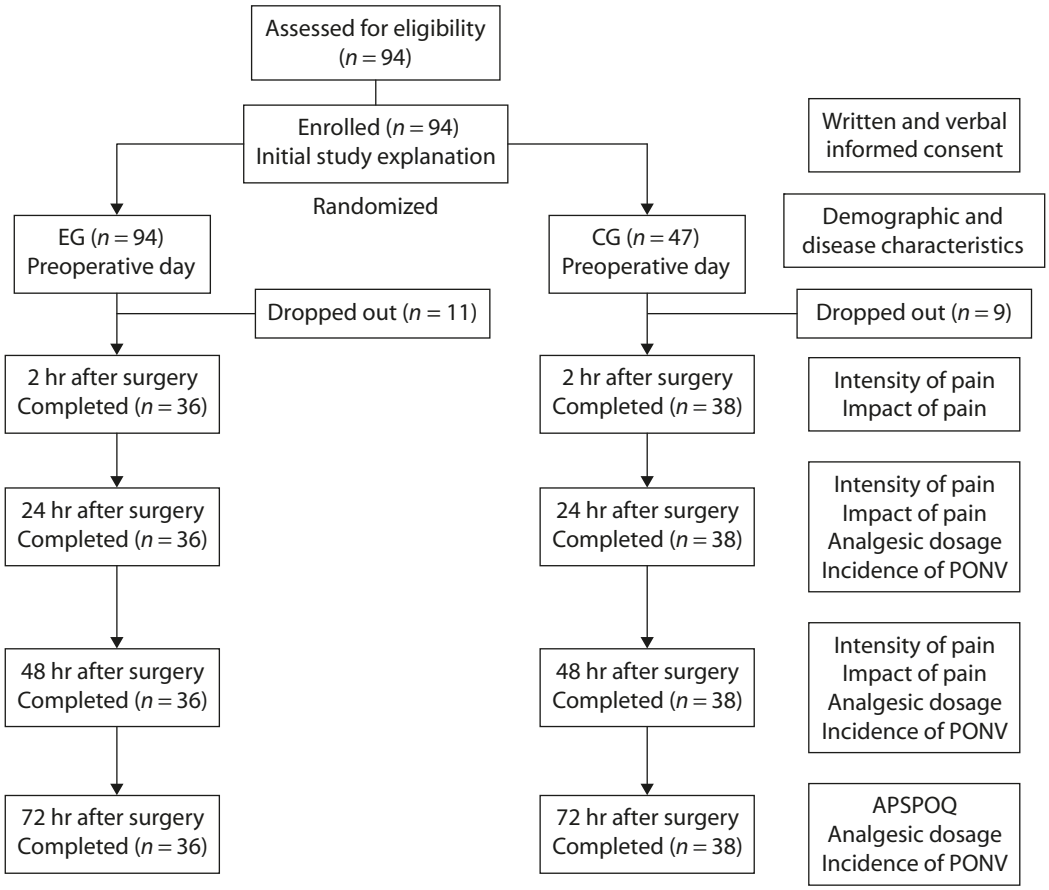

Figure 1 Flow diagram showing the study procedures and number of patients. EG = experimental group; CG = control group; PONV = postoperative nausea and vomiting; APSPOQ = American Pain Society Patient Outcome Questionnaire.

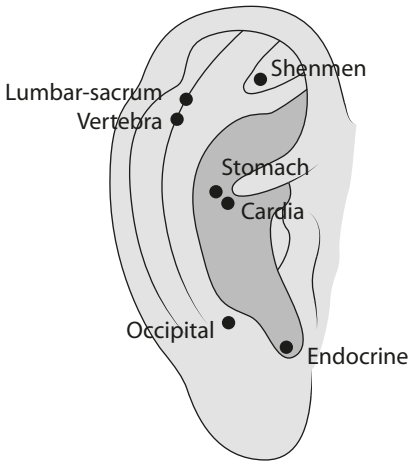

Figure 2 The auricular acupoints: shenmen on the superior and central tip of the triangular fossa; lumbar–sacrum vertebra on the superior helix tail, below Darwin's tubercle; stomach on the medial conchal ridge; cardia on the superior tragus; occipital on the peripheral superior antitragus; and endocrine on the wall of the intertragic notch.

regions involving three or fewer lumbar vertebrae with implanted steel nails, American Society of Anesthesiologists physical status Class I–II, patient consent for intravenous PCA with 100 mg morphine and 2 mL/100 mL droperidol, and returning to the ward from the recovery room. Exclusion criteria were abnormally shaped earlobes, presence of malignant tumors or serious illness, use of antiemetics before surgery, and drug/alcohol addiction. At the end of the operation, the intravenous PCA was connected to the central venous line, set to deliver a bolus of 3 mg morphine, with a lockout interval of 8 minutes, and a 4-hour maximum morphine dose of 10 mg.

Auricular acupressure involved embedding the seeds of the Wang Bu Liu Xing on the auricular acupoints (Figure 2): the shenmen (TF4), occipital (AT3) and lumbar-sacrum vertebra (AH9), the stomach (CO4), cardia (CO3), and endocrine (CO18). These acupoints work on calming and reducing pain, anxiety, PONV, and digestive problems.[22] Acupressure was applied by repeatedly pressing the acupoints with the fingertips for 3 minutes per point, four times per day, and ended 72 hours after surgery. The seeds were kept in place unilaterally by applying an adhesive patch onto the acupoints. Subjects were instructed by the researcher on how to apply auricular acupressure. To validate the auricular acupressure, two clinical acupuncture experts confirmed the acupoints and performance. The subjects received guidance from a researcher to maintain their compliance and accurate acupressure performance.

Data were collected using structured questionnaires. Demographic and disease characteristics included disease history, operation duration, volume of blood loss, and numbers of postoperative drains. The American Pain Society Patient Outcome Questionnaire (APSPOQ) was used to evaluate the analgesic quality in terms of pain intensity, impact of pain on body–mind functional status, perception of pain, and satisfaction with pain control.[29] A visual analog scale (0–10) was used to evaluate pain intensity. The impact of pain was scored as 0–10. The perception of pain was scored as 0–5. Satisfaction with pain control was scored as 0–6. The content validity index of the APSPOQ was 0.92, and Cronbach's α was 0.80 in this study. We also recorded analgesic dose, pain medication, and incidence of PONV.

The study was approved after ethics examination and research planning by the human experiment council at the study hospital and data collection at the study sites was approved by the hospital information bank. The outcomes were evaluated at 2, 24, 24–48, and 48–72 hours after surgery. All data were analyzed using SPSS version 17.0 (SPSS Inc., Chicago, IL, USA). Descriptive analyses, *t* tests, χ^2 tests, Mann-Whitney test, and generalized estimating equation models were used as appropriate. Probability values of less than 0.05 were considered significant.

3. Results

A total of 94 subjects participated in the study, with 74 completing the study. Five withdrew before data collection, and 15 were excluded (eight lacked complete information; four refused auricular acupressure; one had the PCA device removed early; one underwent surgery again; and one remained unconscious after surgery). Therefore, the attrition rate was 21.28%. The subjects were aged 19–87 years, with a mean of 58 ± 15.7 years. Comparisons of the characteristics of subjects who completed the study ($n=74$) and those who withdrew ($n=15$) showed no between-group differences. Furthermore, there were no differences between the experimental and control groups in terms of demographic and disease characteristics for those who completed the study (Table 1).

Figure 3 shows that pain showed a trend to decrease over time in both groups. Moreover, no significant between-group differences were found in the average pain over time (Table 2). Table 3 summarizes the results of analgesic quality. Repeated measurements over time for the intensity and impact of pain, except for walking ability, showed no statistical difference between the two groups. The emergence of pain, worst pain, and average pain were notable at 2 hours after surgery. In addition, there were no differences between the two groups in terms of pain perception and analgesic satisfaction. As shown in Figure 4, the postoperative doses

Table 1 Demographic and clinical characteristics of the subjects who completed the study*

	Experimental group† (n=36)	Control group (n=38)
Age (yr)	58.8±136	55.1±16.1
Sex		
Male	12 (33.3)	13 (34.2)
Female	24 (66.7)	25 (65.8)
Smoking		
No	31 (86.1)	30 (78.9)
Yes	5 (13.9)	8 (21.1)
History of postoperative vomiting		
No	32 (88.9)	36 (94.7)
Yes	4 (11.1)	2 (5.3)
History of spinal surgery		
No	30 (83.3)	31 (81.6)
Yes	6 (16.7)	7 (18.4)
Hypertension		
No	27 (75.0)	31 (81.6)
Yes	9 (25.0)	7 (18.4)
Diabetes		
No	32 (88.9)	37 (97.4)
Yes	4 (11.1)	1 (2.6)
ASA class		
I	8 (22.2)	7 (18.4)
II	28 (77.8)	31 (81.6)
Operation duration	201.8±54.3	200.2±50.7
Amount of blood loss (mL)	624.4±457.0	518.2±373.0
Number of postoperative drains		
One	32 (88.9)	36 (94.7)
Two	4 (11.1)	2 (5.3)

*Data presented as mean±standard deviation or n (%); †p>0.05 *vs*. control group. ASA=American Society of Anesthesiologists.

of morphine gradually decreased in both groups over time. As shown in Table 4, there were no between-group differences in postoperative morphine use over time. In addition, there were no differences between the experimental and control groups in terms of duration of PCA use (66.7±5.2 hours *vs*. 66.8±2.8 hours, respectively) or total morphine dose (62.5±23.3 mg *vs*. 70±25 mg, respectively). During the study period, four subjects (10.8%) requested muscle injections of Demerol (50 mg). The rate of vomiting on the first operative day was 19.4% and 7.9% in the experimental and control groups, respectively, with no between-group difference (χ^2=2.11, p=0.15). The incidence of PONV was 38.9% and 34.2% in the experimental group and control groups, respectively, with no between-group difference (χ^2=0.18, p=0.68).

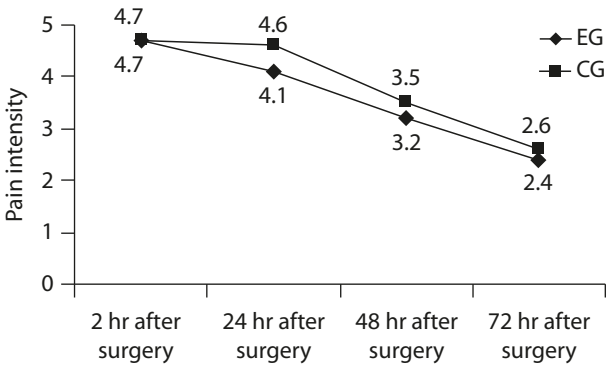

Figure 3 Changes in pain intensity over time. Data are presented as mean visual analog score (0–10). p>0.05 *vs*. CG. EG=experimental group (n=36); CG=control group (n=38).

Table 2 Generalized estimating equation model for pain intensity at each observation*

	β	SE	p
Intercept	4.90	0.34	<0.001
EG	–0.20	0.55	0.72
EG×24 hr†	–0.35	0.44	0.43
EG×24–48 hr†	–0.13	0.51	0.80
EG×48–72 hr†	–0.04	0.55	0.94

*The control group or values at 2 hours were used as reference values; †interaction between EG and time. SE=standard error; EG=experimental group.

4. Discussion

This study revealed that postoperative pain was, on average, greatest on the day of surgery. In both groups, the pain was moderate but decreased over time, and was attenuated by day 3 after surgery. However, the greatest pain in both groups remained moderate. This is consistent with an earlier study showing that pain decreases over time after surgery.[30] In this study, the use of auricular acupressure in the experimental group did not provide substantial improvements in pain control after surgery, as compared with the control group, with comparable pain impact and pain perception in both groups. These results are similar to an earlier study on relieving acute pain syndromes, in that although the auricular acupuncture group experienced significantly lighter pain than did the standard treatment group,

Table 3 Mann-Whitney test for comparison of analgesic quality after surgery*

	2 hr		24 hr		24–48 hr		48–72 hr	
	EG	CG	EG	CG	EG	CG	EG	CG
Intensity of pain								
Pain level at present	4.0	5.0	3.0	4.0	3.0	3.0	2.0	1.5
Worst pain in the past	6.0	7.0	5.5	7.0	5.0	5.0	4.0	4.0
Average pain in the past	4.0	5.0	3.0	4.0	3.0	3.0	2.0	2.0
Impact of pain								
Activities	9.0	9.0	8.0	8.0	7.0	6.0	5.0	4.0
Walking ability	10.0	10.0	10.0	10.0	10.0	10.0	9.0†	7.0
Sleep	5.0	4.0	3.0	3.0	2.0	3.0	2.0	2.5
Perception of pain								
Analgesia cannot control pain							1.0	2.0
Analgesia causes drug addiction							0.5	2.5
Enduring pain is easier than side effects of analgesia							1.0	2.0
Good patients should avoid reporting pain							0.0	0.0
Pain indicates deterioration of health condition							0.0	0.0
Analgesic satisfaction							5.0	5.0

*Median values; †$p<0.05$ *vs.* CG. EG=experimental group ($n=36$); CG=control group ($n=38$).

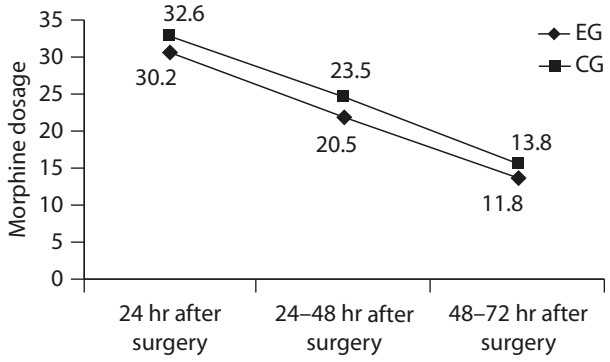

Figure 4 Trends in morphine consumption over time. Data are presented as mean. $p>0.05$ *vs.* CG. EG=experimental group; CG=control group.

Table 4 Generalized estimating equation model results for analgesic dose at each observation*

	β	SE	*p*
Intercept	32.65	1.57	<0.001
EG	−2.42	2.36	0.31
EG×24–48 hr†	−0.60	1.98	0.76
EG×48–72 hr†	0.38	2.15	0.86

*The control group or values at 24 hours were used as reference values; †interaction between EG and time. SE=standard error; EG=experimental group.

both groups continued to experience moderate pain.[31] In another study that used auricular acupressure in combination with PCA, but without limiting the duration of pressure application, no attenuation of pain was found.[24] In contrast, in a study of elderly patients with acute hip fracture, auricular acupressure effectively reduced pain from moderate to mild, whereas pain in the sham group remained at a moderate level.[32]

The findings of this study are not fully consistent with some of the studies mentioned above. The reasons for these differences may include differences in surgical site, as well as frequency and duration of applying acupressure. In this study, the intervention involved teaching patients the correct acupressure method, and embedding and confirming the acupoint locations. The subjects themselves performed the acupressure following the protocol. Though the subjects verbally confirmed their compliance, it is possible that they did not fully comply with the regimen. Furthermore, because the pain score peaked at around 24 hours postoperatively, it seems possible that the auricular acupressure was ineffective because the stimulus was performed at a suboptimal level. Electrical stimulation is probably more effective than manual procedures for activating acupuncture.[33] The average pain score remained at a moderate level during the day of surgery and the days after. This shows that auricular acupressure in combination with PCA did not reduce pain to a milder level. Therefore, in future use

of auricular acupressure for postoperative patients likely to experience severe pain, one must consider adjusting the timing and intensity of the regimen.

Although the level of pain was not significantly reduced by acupressure, pain scores tended to be lower in the acupressure group than in the control group at each observation, suggesting that it still had some merit. Regarding the impacts of pain, interference with walking ability was the most widely reported, followed by other activities such as changing position. Nevertheless, only 5.4% of the subjects requested other analgesics in addition to PCA on the first operative day. In terms of pain perception, the subjects also believed that analgesia can cause drug addiction, which was associated with insufficient use of analgesic. In contrast, most of the subjects were satisfied with their pain management, even though they experienced at least moderate pain. These results are similar to those of some earlier studies.[34] Over 90% of subjects would like to use such methods to control pain in the future, if needed. These findings bring up a cultural issue—Chinese people are passive in requesting pain treatment and therefore receive less analgesia, particularly surgical patients.[35] In fact, the most common method used by Chinese people to manage moderate or severe postoperative pain that interferes with daily activities is to tolerate the pain.[35] Patients' pain perception can reduce their desire for postoperative pain relief with appropriate analgesics.[36] In general, Chinese people are less likely to request analgesics because of their fear of addiction.[37]

The effect of acupressure on reducing the incidence of PONV was not supported by this study, although the vomiting rate on the first operative day was lower in the auricular acupressure group than in the control group. However, morphine consumption within the first 24 hours after surgery in this study was lower than that in a study involving lumbar fusion patients.[38] In that study, the total PCA morphine dose was 33 ± 20 mg for the experimental subjects with a vomiting rate of 28% in 18.4 hours, and 49 ± 21 mg for the control subjects with a vomiting rate of 32% in 16.7 hours. The low vomiting rate in our study may be explained by the lower use of PCA if the morphine dose is the greatest predictor of PONV.[39] Although PCA augmented by auricular acupressure did not provide greater pain relief after lumbar surgery or prevent PONV, the subjects were satisfied with the level of pain relief.

This study adopted a single-blind, randomized control, although a double-blind design may be more appropriate. In future studies, a placebo group could be included to exclude possible placebo effects. This study was unable to exclude the influence of whether the acupressure was performed in a timely manner. Thus, future studies should investigate the possible effects of timing and frequency of acupressure on pain control.

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