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Comparative Effects of P6 Acupressure Wristbands and Press Needle on Postoperative Pain Following Laparoscopic Cholecystectomy: A Randomized Controlled Trial

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Abstract

Background:

Postoperative pain remains a common challenge following laparoscopic cholecystectomy despite advances in surgical techniques. Non-pharmacological approaches such as acupressure have been proposed as adjuncts to conventional analgesia. This study aimed to compare the effects of P6 acupressure applied via wristbands and press needles on postoperative pain intensity and analgesic consumption.

Methods:

This single-blind, five-arm randomized controlled trial was conducted on 175 patients undergoing laparoscopic cholecystectomy. Participants were allocated into five groups (n = 35 each): acupressure wristband, wristband placebo, press needle, press needle placebo, and control. Interventions were applied one hour before surgery and maintained for six hours postoperatively. Pain intensity was measured using the Visual Analog Scale at 0–1, 1–6, and 6–24 hours after surgery. Analgesic consumption within 24 hours was also recorded. Data were analyzed using appropriate statistical tests with a significance level of 0.05.

Results:

Pain intensity differed significantly among groups during the early (0–1 h) and late (6–24 h) postoperative periods ($p < 0.05$), but not during the intermediate period (1–6 h). Patients in the acupressure wristband and press needle groups reported lower pain scores and required fewer analgesics compared to placebo and control groups ($p < 0.001$). No significant differences were observed between the two intervention modalities.

Conclusion:

P6 acupressure using either wristbands or press needles is an effective complementary method for reducing postoperative pain and analgesic use following laparoscopic cholecystectomy. Its incorporation into multimodal pain management strategies may enhance postoperative recovery.

Keywords: Acupressure Therapy, Neiguan Point (PC6), Pain, Postoperative Cholecystectomy, Opioid, Complementary Therapies, Pain Measurement

Trial registration: Iranian Registry of Clinical Trials (IRCT) IRCT20190915044770N1; registered on 25 October 2019.

Introduction:

Postoperative pain remains a major clinical concern following abdominal surgeries, including laparoscopic cholecystectomy, despite advances in minimally invasive techniques and perioperative care [1,2]. Although laparoscopic approaches are associated with reduced tissue trauma and faster recovery compared to open procedures, a considerable proportion of patients continue to experience moderate to severe pain within the first 24 hours after surgery [3]. Inadequate pain control may delay recovery, prolong hospitalization, and negatively affect patient satisfaction and clinical outcomes [4].

Pharmacological interventions, particularly opioid and non-opioid analgesics, remain the cornerstone of postoperative pain management. However, their use is frequently limited by adverse effects such as nausea, vomiting, respiratory depression, and risk of dependency [5,6]. Consequently, there has been growing interest in complementary and non-pharmacological approaches as adjuncts to conventional pain management strategies [7].

Acupressure, a non-invasive technique derived from traditional medicine, involves the application of pressure to specific points on the body to regulate physiological processes [8]. Among these, the Neiguan (P6) acupoint has been extensively investigated for its role in reducing pain, nausea, and vomiting [9,10]. Evidence suggests that stimulation of the P6 point may modulate central and peripheral pain pathways, possibly through neurochemical mechanisms involving endorphin release and autonomic regulation [11].

Different modalities have been used to stimulate the P6 point, including manual acupressure, wristbands, and press needles [12]. Previous studies have demonstrated the effectiveness of P6 stimulation in reducing postoperative pain and related symptoms. For instance, Lee et al. reported a significant reduction in pain intensity following P6 acupressure [13], while Sadri et al. showed that acupressure significantly reduced postoperative pain and nausea [14].

Despite the growing body of evidence, comparative studies evaluating different acupressure modalities remain limited. Therefore, the present randomized controlled trial aimed to compare the effects of P6 acupressure administered via wristbands and press needles on postoperative pain and analgesic consumption.

Study design and setting

This study was designed as a single-blind, five-arm randomized controlled trial conducted at Besat Teaching Hospital, a tertiary care center affiliated with Hamadan University of Medical Sciences, Iran. The study was carried out over a five-month period from November 2019 to March 2020. This study was reported in accordance with the CONSORT (Consolidated Standards of Reporting Trials) guidelines.

Written informed consent was obtained from all participants prior to enrollment. All procedures were conducted in accordance with the Declaration of Helsinki.

Participants

The study population consisted of adult patients scheduled for elective laparoscopic cholecystectomy under general anesthesia.

Inclusion criteria:

- Age $\geq$ 18 years
- Candidate for laparoscopic cholecystectomy
- Ability to understand and use the Visual Analog Scale (VAS)
- No preoperative nausea or vomiting
- Intact skin at the P6 acupoint site
- No intravenous lines or medical devices at the intervention site

Exclusion criteria:

- Withdrawal from the study
- Conversion to open surgery
- Reoperation during the study period
- Local sensitivity or adverse reaction to wristband or press needle
- Any intraoperative or postoperative complication affecting pain assessment

All participants provided written informed consent prior to enrollment.

Sample size

The sample size was calculated based on previous studies reporting variability in postoperative symptoms, assuming a significance level of 0.05 and a statistical power of 80%. Considering an

expected effect size and a 10% attrition rate, a total sample size of 175 participants (35 per group) was determined.

Randomization and allocation

Participants were allocated into five groups (n=35 each):

- A1: Acupressure wristband
- A2: Wristband placebo
- B1: Press needle
- B2: Press needle placebo
- C: Control

To minimize contamination between intervention groups within the surgical setting, a **time-based allocation approach (by operative day)** was implemented. Each working day of the week was randomly assigned to one of the five study groups using a lottery method prior to study initiation. All eligible patients undergoing surgery on a given day were assigned to the corresponding group.

Although individual-level randomization is generally preferred, this clustered time-based allocation was adopted to reduce treatment contamination and ensure protocol adherence in a high-throughput surgical environment.

Blinding

This study was conducted as a single-blind trial. Participants in the placebo groups were unaware of the nature of the intervention. Outcome assessment was performed using standardized tools to minimize measurement bias.

Intervention

The P6 (Neiguan) acupoint was identified as three fingerbreadths proximal to the wrist crease between the tendons of palmaris longus and flexor carpi radialis.

Intervention groups:

The acupressure wristband used in this study was the AD-9 model (manufactured in Iran), and the press needle device was the Huan Qiu brand (manufactured in China). Both devices were applied according to the manufacturers' instructions.

- **Wristband group (A1):**
A commercially available acupressure wristband was applied to exert continuous pressure on the P6 point one hour before anesthesia induction and maintained for six hours postoperatively.
- **Wristband placebo group (A2):**
An identical wristband without the pressure-inducing stud was applied at the same location and duration.
- **Press needle group (B1):**
A sterile press needle device was applied to the P6 point one hour prior to surgery and remained in place for six hours postoperatively.
- **Press needle placebo group (B2):**
A similar adhesive patch without an embedded needle was applied.
- **Control group (C):**
Patients received routine perioperative care without any acupressure intervention.

All participants received standard anesthesia and postoperative care protocols.

Outcome measures

Primary outcome:

- Postoperative pain intensity measured using the Visual Analog Scale (VAS; 0–100 mm)

Pain was assessed at three time intervals:

- 0–1 hour postoperatively (T0–T1)
- 1–6 hours postoperatively (T1–T6)
- 6–24 hours postoperatively (T6–T24)

Secondary outcomes:

- Frequency of pain occurrence
- Analgesic consumption within the first 24 hours postoperatively

Data collection

Data were collected using structured forms including:

- Demographic characteristics (age, sex, BMI, etc.)
- Clinical variables (medications, anesthesia details)

- Pain assessment records (VAS), Pain intensity was assessed using the Visual Analog Scale (VAS), a validated tool widely used in clinical pain research [6].
- Analgesic usage

All patients were instructed on how to use the VAS prior to surgery.

Statistical analysis

Data were analyzed using SPSS software version 20. Descriptive statistics (mean, standard deviation, frequency) were used to summarize baseline characteristics.

Normality of data distribution was assessed using the Kolmogorov–Smirnov test. Depending on data distribution, appropriate inferential statistical tests were applied, including:

- Kruskal–Wallis test for group comparisons
- Mann–Whitney U test for pairwise comparisons
- Wilcoxon test for within-group analysis
- Spearman correlation analysis where applicable

A p-value of less than 0.05 was considered statistically significant.

Ethical considerations

The study protocol was approved by the Ethics Committee of Hamadan University of Medical Sciences (IR.UMSHA.REC.1398.428). Written informed consent was obtained from all participants prior to enrollment. All procedures were conducted in accordance with the Declaration of Helsinki.

This trial was registered in the Iranian Registry of Clinical Trials (IRCT) (Registration number: IRCT20190915044770N1; Registration date: 2019-10-25; Available at: <https://www.irct.ir/trial/42125>).

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Results:

Participant characteristics

A total of 175 patients were allocated into five study groups according to the predefined allocation schedule, (n = 35 per group): acupressure wristband (A1), wristband placebo (A2), press needle (B1), press needle placebo (B2), and control (C).

A total of 175 patients were assessed for eligibility and randomized into five groups. The flow of participants through the study is presented in Figure 1.

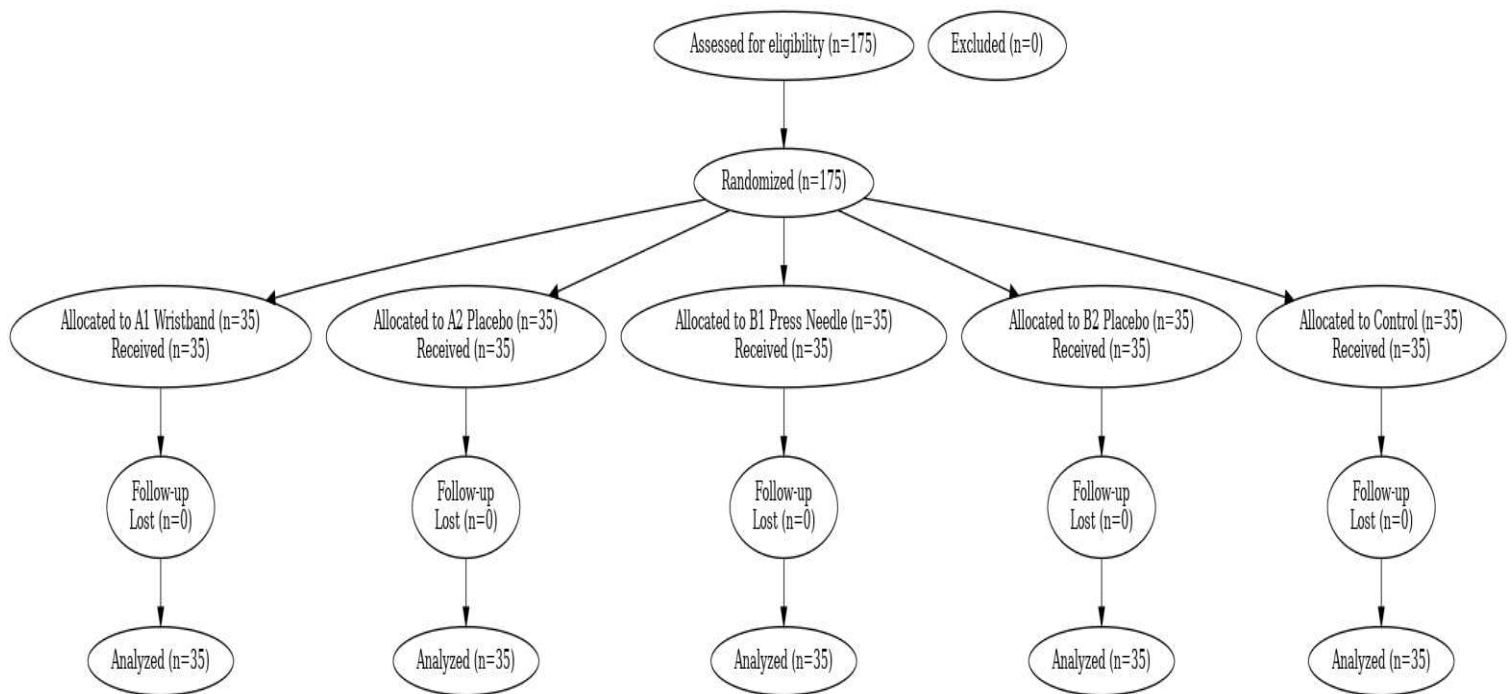


Figure 1. CONSORT flow diagram illustrating the process of patient enrollment, randomization, allocation to intervention groups (wristband, press needle, placebo, and control), follow-up, and analysis in this randomized controlled trial.

Baseline characteristics of participants are presented in Table 1. No statistically significant differences were observed among the five groups in terms of age ($p = 0.625$) or body mass index ($p = 0.138$).

Table 1. Baseline continuous variables of participants (Mean $\pm$ SD)

Variable	A1 Wristband	A2 Placebo Wristband	B1 Press Needle	B2 Placebo Press Needle	Control	Test Statistic	p-value
Age (years)	35.34 $\pm$ 12.64	48.89 $\pm$ 10.98	48.86 $\pm$ 12.24	46.49 $\pm$ 13.05	45.66 $\pm$ 13.57	F = 0.65	0.625
BMI (kg/m²)	26.94 $\pm$ 4.55	28.13 $\pm$ 3.41	28.32 $\pm$ 5.08	26.10 $\pm$ 2.72	27.61 $\pm$ 4.06	F = 1.76	0.138

Categorical variables, including sex, marital status, educational level, smoking status, substance use, and perioperative medication use, were also comparable across groups (all $p > 0.05$), as shown in Table 2.

Table 2. Baseline categorical variables of participants (n, %)

Variable	Category	A1 Wristband	A2 Placebo Wristband	B1 Press Needle	B2 Placebo Press Needle	Control	p-value
Sex	Male	1 (2.9)	0 (0.0)	1 (2.9)	6 (17.1)	4 (11.4)	0.245
	Female	34 (97.1)	35 (100)	34 (97.1)	29 (82.9)	31 (88.6)	
Marital status	Single	0 (0.0)	2 (5.7)	0 (0.0)	1 (2.9)	2 (5.7)	0.079
	Married	35 (100)	31 (88.6)	35 (100)	32 (91.4)	31 (88.6)	
	Divorced/Widowed	0 (0.0)	2 (5.7)	0 (0.0)	2 (5.7)	2 (5.7)	
Education	Illiterate	6 (17.1)	10 (28.6)	14 (40.0)	9 (25.7)	11 (31.4)	0.564

	Primary	18 (51.4)	13 (37.1)	15 (42.9)	19 (54.3)	12 (34.3)	
	Diploma+	11 (31.4)	12 (34.3)	6 (17.1)	7 (20.0)	12 (34.3)	
Smoking	Yes	0 (0.0)	1 (2.9)	2 (5.7)	2 (5.7)	2 (5.7)	0.773
Substance use	Yes	1 (2.9)	0 (0.0)	1 (2.9)	3 (8.6)	1 (2.9)	0.522
Fentanyl (premedication)	Yes	21 (60.0)	22 (62.9)	28 (80.0)	27 (77.1)	23 (65.7)	0.268
Sufentanil (premedication)	Yes	14 (40.0)	12 (34.3)	9 (25.7)	8 (22.9)	12 (34.3)	0.528

Postoperative pain intensity

Postoperative pain intensity scores at different time intervals are presented in Table 3.

Table 3. Postoperative pain intensity (VAS scores, Mean $\pm$ SD)

Time Interval	A1 Wristband	A2 Placebo Wristband	B1 Press Needle	B2 Placebo Press Needle	Control	Test Statistic	p-value
T0–T1 (0–1 h)	1.60 $\pm$ 2.38	0.34 $\pm$ 0.16	0.89 $\pm$ 1.84	0.46 $\pm$ 1.46	1.43 $\pm$ 2.36	F = 4.30	0.002
T1–T6 (1–6 h)	3.03 $\pm$ 2.22	3.86 $\pm$ 2.17	2.89 $\pm$ 2.01	4.37 $\pm$ 2.10	3.91 $\pm$ 2.42	F = 0.36	0.837
T6–T24 (6–24 h)	1.37 $\pm$ 1.77	3.26 $\pm$ 2.25	0.94 $\pm$ 1.68	4.23 $\pm$ 2.26	1.83 $\pm$ 2.16	F = 10.21	0.001

There was a statistically significant difference in pain intensity among the five groups during the early postoperative period (T0–T1) ($F = 4.30$, $p = 0.002$). A significant difference was also observed during the late postoperative period (T6–T24) ($F = 10.21$, $p = 0.001$).

No statistically significant difference was detected during the intermediate postoperative period (T1–T6) ($F = 0.36$, $p = 0.837$).

Analgesic consumption and pain frequency

Analgesic consumption within the first 24 hours postoperatively differed significantly among the five groups ($p < 0.001$), with lower analgesic use observed in the acupressure wristband and press needle groups.

The frequency of postoperative pain also differed significantly between groups during the early (T0–T1) and late (T6–T24) periods ($p < 0.001$), while no significant difference was observed during the intermediate period (T1–T6).

Discussion:

Principal findings

The present randomized controlled trial demonstrated that P6 acupressure, applied either via wristbands or press needles, significantly reduced postoperative pain intensity and analgesic consumption following laparoscopic cholecystectomy. The most pronounced effects were observed during the early (0–1 h) and late (6–24 h) postoperative periods, whereas no significant differences were detected during the intermediate phase (1–6 h). These findings suggest a time-dependent analgesic effect of P6 stimulation in the acute postoperative phase.

Interpretation of findings

The observed reduction in postoperative pain supports the growing body of evidence indicating that stimulation of the Neiguan (P6) acupoint may modulate pain perception through neurophysiological pathways. It has been proposed that acupressure activates afferent nerve fibers, leading to the release of endogenous opioids such as endorphins and enkephalins, as well as modulation of autonomic nervous system activity [11,18].

In line with our findings, Lee et al. reported that P6 stimulation significantly reduced pain intensity in obstetric populations, highlighting its analgesic potential beyond antiemetic effects [13]. Similarly, Sadri et al. demonstrated that P6 acupressure significantly decreased postoperative pain and analgesic requirements in surgical patients, supporting the adjunctive role of this intervention in perioperative care [14].

More recent evidence has reinforced these findings. A 2023 systematic review by Yang et al. indicated that acupressure interventions targeting P6 are associated with reduced postoperative pain scores and opioid consumption across various surgical populations [15]. Likewise, a 2024 randomized trial by Zhang et al. reported that non-invasive acupoint stimulation significantly improved postoperative recovery quality and reduced opioid-related side effects in abdominal surgery patients [16].

Comparison of intervention modalities

An important finding of the present study is that both wristband and press needle modalities demonstrated comparable efficacy in reducing postoperative pain. While wristbands provide continuous external mechanical stimulation, press needles may offer more stable and localized pressure at the acupoint.

Although few studies have directly compared these two modalities, existing literature suggests that the effectiveness of acupressure is more dependent on continuous stimulation rather than the specific device used [17]. Our results support this hypothesis, indicating that both methods may be clinically interchangeable in postoperative pain management.

Mechanistic considerations

The analgesic effects observed in this study may be explained through multiple mechanisms. Stimulation of P6 has been shown to influence the hypothalamic–pituitary–adrenal axis and increase endogenous opioid release, thereby reducing pain perception [18]. Additionally, modulation of sympathetic activity may contribute to decreased stress responses in the immediate postoperative period.

Furthermore, the gate control theory of pain provides a plausible explanation, suggesting that peripheral stimulation at specific acupoints may inhibit nociceptive transmission at the spinal cord level [19].

Clinical implications

Given the simplicity, low cost, and non-invasive nature of P6 acupressure, both wristbands and press needles may be considered as adjunctive tools in multimodal postoperative pain management strategies. Their integration into perioperative care protocols could potentially reduce reliance on opioid analgesics and improve patient recovery profiles.

Recent guidelines in perioperative pain management have increasingly emphasized multimodal and non-pharmacological interventions as part of enhanced recovery after surgery (ERAS) pathways [20]. The findings of this study are consistent with this paradigm shift.

Strengths and limitations

This study has several strengths, including its randomized controlled design, use of placebo groups, and multi-arm comparison of two different acupressure modalities. Additionally, pain was assessed at multiple postoperative time points, providing a dynamic evaluation of analgesic effects. Our findings are consistent with recent evidence, including a randomized controlled trial by Asadi et al. (2025), which demonstrated that auricular acupressure significantly improved pain and physiological outcomes following coronary angiography [16].

However, several limitations should be acknowledged. First, the use of a time-based allocation method may introduce potential selection bias despite efforts to minimize contamination. Second, the study was conducted in a single center, which may limit generalizability. Third, blinding was not complete due to the nature of the intervention.

Conclusion

P6 acupressure, delivered via wristbands or press needles, is an effective complementary approach for reducing postoperative pain and analgesic consumption after laparoscopic cholecystectomy. Given its safety, accessibility, and non-invasive nature, it may be considered as part of multimodal perioperative pain management strategies.

Further multicenter studies with larger sample sizes and standardized protocols are recommended to confirm these findings and compare long-term outcomes.

Declarations

Ethics approval and consent to participate

The study protocol was approved by the Ethics Committee of Hamadan University of Medical Sciences (IR.UMSHA.REC.1398.428). Written informed consent was obtained from all participants prior to enrollment. All procedures were conducted in accordance with the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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