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Research

The Effects of Inhalation Aromatherapy Using Lavender Essential Oil on Postoperative Pain of Inguinal Hernia: A Randomized Controlled Trial

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A B S T R A C T

Purpose: One of the main problems after inguinal hernia surgery is postoperative pain. The purpose of this study was to examine the effects of aromatherapy with lavender oil inhalation on postoperative pain after inguinal hernia surgery.
Design: A randomized controlled design was used.
Methods: Ninety participants were selected and assigned to two groups: the intervention group ($n = 45$) and the control group ($n = 45$). The patients in the intervention group inhaled four drops of 2% lavender essential oil with oxygen for 20 minutes. The patients in the control group inhaled only oxygen. Postoperative pain was measured 0 minutes after being transferred to the surgery ward, and then 2 hours, 6 hours, and 24 hours after surgery using the visual analog scale.
Findings: In comparison to the control group, levels of pain severity in the intervention group were significantly lower in four stages of measurements ($P < .001$). Also, in all stages, measurements showed significant statistical differences within the groups ($P < .001$).
Conclusions: Aromatherapy with lavender essential oil helped decrease postoperative pain after inguinal hernia surgery.

Surgery is the most common method of treatment for inguinal hernia.[1] Surgery can cause physical and psychological issues in patients.[2] The main complication of surgery is the postoperative pain that begins with surgical trauma and decreases with tissue improvement.[3]

Adequate postoperative pain management is considered to be the basic right of a patient and one of the most important components of appropriate postoperative care.[4] Poor management of postoperative pain can contribute to complications such as pneumonia, deep vein thrombosis, infections, chronic pain, and depression.[5] The effective management of postoperative pain, especially during the first 24 hours after surgery, reduces postoperative complications, including the reduction of the incidence of chronic postoperative pain, especially in the surgery zone.[6] However, no ideal strategy is available for the management of postoperative pain.[3]

Although the responsibility for pain management is considered to be the obligation of all health care professions, it is the primary role of nurses and an integral part of the concept of care in the nursing profession.[7] Pain relief in patients leads to their acceptance of caring procedures, and finally, to the improvement of their quality of life. Therefore, the nursing staff is always in search of effective pain control modalities.[8] The main strategy in

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postoperative pain control is the administration of standard analgesics and analgesia techniques. Although medications can assist in getting pain under control, they are associated with adverse effects such as respiratory depression, nausea, itching, and intestinal paralysis.[9]

In contrast, nonpharmacologic methods are low risk, practical, and achievable and applicable in terms of cost benefit in clinical practice. Nonpharmacologic interventions are regarded as a part of complementary medicine.[10] Complementary and alternative medicine (CAM) is growing and evolving in the health care system.[11] An increasing number of patients will be attracted to CAM in the near future to address the consequences of surgery such as postoperative pain.[4] CAM therapies, such as nonpharmacologic interventions (ie, aromatherapy),[12] are mainly within the nursing practice domain, and they are used for supporting the comfort of patients and reducing their discomfort.[13] Aromatherapy uses natural essential oils, absorbed through the skin or olfactory system, for therapeutic purposes.[14] Aromatherapy has been widely used as a nursing intervention worldwide,[10] and many patients and health care providers are interested in this method because of its low cost and side effects, but its advantages have remained controversial.[15] Olfactory stimulation using natural essential oils derived from plants is associated with the immediate reduction of pain.[14] However, its impact on the reduction of pain requires more research.

Lavandula, one of the plants whose essential oil is used in aromatherapy, is more commonly known as lavender. Lavender is one of the aromatic species of labiatae, which has certain therapeutic properties that are widely used in aromatherapy.[16] Linalool and linalyl acetate found in lavender can stimulate the parasympathetic system, which influences the mood states, and as a result, subjects feel more comfortable, relaxed, active, and less sleepy.[17] Also, the effects of lavender on pain relief have been investigated by previous studies on labor pain,[18] cesarean section pain,[19] needle insertion–related pain,[16,20] pain after open heart surgery,[21] post-tonsillectomy pain,[22] and neuropathic pain.[23] In addition, it has been suggested that aromatherapy can be an effective strategy for relieving anxiety,[24] postoperative nausea and vomiting,[25] and hemodynamic instabilities.[26]

Given that no study was available on the effects of aromatherapy using lavender essential oil on pain after inguinal hernia surgery, the purpose of this study was to investigate the effectiveness of aromatherapy with lavender essential oil inhalation on postoperative pain in patients undergoing inguinal hernia surgery.

Methods

Study Design

This study was a double-blind, two-armed, and randomized controlled trial. It was conducted from June 2016 to February 2017 on patients undergoing inguinal hernia surgery in a referral teaching hospital in an urban area of Iran.

Participants

Eligibility criteria were as follows: being able to speak Farsi; being a candidate for undergoing inguinal hernia surgery, including direct and indirect hernia; no history of surgery; no history of allergy to lavender, age range of 18 to 65 years; no respiratory disorders; no addiction to narcotics; and not receiving any type of analgesics within 2 hours before the surgery. The use of postoperative opioid analgesics; the use of opioids for chronic pain, eczema, or allergy to lavender; hemodynamic instability; liver disorders; and patients needing medical care during the intervention were the basis for exclusion.

The sample size was estimated at 40 subjects in each group using the results of the study by Heidari Gorji et al,[27] with a 95% confidence interval (95% CI) and 80% power. Given a 10% probability of sample dropouts, 45 patients were determined for each group. The patients were selected through a convenience sampling method. They were assessed for eligibility before the surgery. Of 155 patients, 90 eligible patients were assigned to the groups using a randomized block design as follows: code A was given to the intervention group, and code B was given to the control group. Next, the random allocation sequence (21 quadruple blocks and one sextuple block) was generated using the syntax of SPSS, version 25, software (IBM, Armonk, NY) by the statistical adviser of the study (the fourth author). Then, the eligible participants were allocated by the second author to intervention and control groups according to these blocks. The data collector and data analyzer were blinded (Figure 1).

Intervention

After being transferred to the operating room, each patient in the intervention and control groups was connected to the cardiac monitor for pulse oximetry and noninvasive blood pressure monitoring. Also, 1 mg/kilogram (mg/kg) of fentanyl was administered intravenously (IV). Next, tracheal intubation was conducted and general anesthesia provided using thiopental sodium (5 mg/kg) followed by isoflurane (1% to 1.5%) and nitrous oxide with oxygen (N_2/O_2) at a rate of 3 L/minute (L/min). In addition, tracrium (atracurium) was used to facilitate surgery. The open surgery technique was used for inguinal hernia repair. At the end of surgery, after removing the endotracheal tube and ensuring cardiovascular and respiration stability, the patient was transferred to the postanesthetic recovery unit (recovery unit).[28] Routine interventions before the surgery, anesthesia induction method, type of tracheal tube, anesthesia process, and type of surgery were standard for all the patients in terms of the tracheal tube size, amount of cuff pressure, humidity and heat of gasses, and proper depth of anesthesia.

Immediately on arriving to the recovery unit, oxygen was administered in the intervention group at the rate of 6 L/min[28] using a face mask in combination with lavender essential oil for 20 minutes. The lavender essential oil used in this study was extracted from the *Lavandula angustifolia* species, a common species of lavender.[29] The oil was produced by the Zardband Pharmaceutical Company, Yasuj, Iran (production license: 092-(Z-B)-87-M, and the factory standard: 65/81/00001). Given that pure lavender essential oil is extremely concentrated and can cause irritation,[16] 2% of lavender essential oil was used for inhalation aromatherapy.[21] Therefore, in this study, lavender essential oil was diluted to 2% using sweet almond oil as a carrier.[16] Next, four drops of 2% lavender essential oil were added to 30 mL of distilled water in the humidifier oxygen flow meter.[21] If the patient continued to be in the recovery unit for more than 20 minutes, the oxygen therapy was continued by the routine method with pure distilled water in the humidifier of the oxygen flow meter. The patients in the control group received oxygen therapy identically and without lavender essential oil. To prevent contamination between the groups because of the smell of lavender, one patient was selected in each work shift.

Furthermore, all patients without liver disorders undergoing inguinal surgery receive acetaminophen 325 mg/three times a day in the first 24 hours after surgery as an analgesic.

Data Collection

An individual demographic data questionnaire and the visual analog scale for pain (VAS pain) were used.

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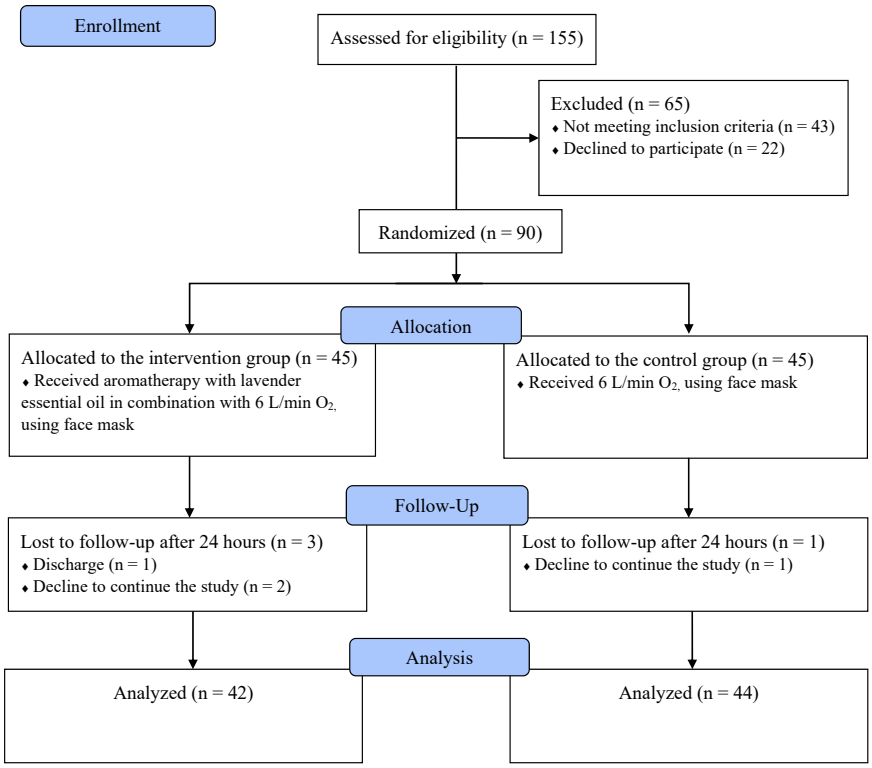

Figure 1. Consolidated Standards of Reporting Trials flow diagram (2010). This figure is available in color online at www.jopan.org.

Individual Demographic Data Questionnaire

The individual demographic data questionnaire consisted of questions about gender, age, and type of hernia and was completed by the researcher before the patients' transfer to the operation room.

VAS Pain

The VAS pain scale is a one-dimensional type of pain intensity measurement that has been widely used in postoperative pain evaluation. It is a single-item and continuous scale comprising a horizontal line or a vertical line, usually 10 cm in length. This is a self-report scale. The respondent was asked to place a line perpendicular to the VAS line at the point that represented their pain intensity. This scale has been shown to have high validity and reliability in both literate and illiterate patients.[30] Score 0 indicates no pain, score 1 to 3 indicates mild pain, score 4 to 6 indicates moderate pain, score 7 to 9 indicates severe pain, and score 10 indicates extremely severe pain. Postoperative pain in this study was measured using the VAS at 0 minutes after being transferred to the surgery ward, and then 2, 6, and 24 hours after the surgery.

Ethical Considerations

The study protocol was approved by Shahroud University of Medical Sciences under the code of IR.SHMU.REC.1395.41.The research protocol was registered at the Iranian Registry of Clinical Trials Web site under the number of IRCT201602103064N1. Permission to enter the research zone was acquired before the study. Information about the study's aim and process and confidentiality of data were given to the subjects. Furthermore, those who agreed to participate in this study signed a written consent form.

Data Analysis

Data analysis was performed using descriptive and inferential statistics via SPSS, version 25, software. The χ^2 test, independent sample *t* test, and Fisher exact test were used for the comparison of participants' characteristics in the groups. In addition, the repeated-measures analysis of variance test was carried out to assess changes in the severity of pain over time. Also, the independent-sample *t* test was applied to compare the levels of pain severity between the groups. The significance level was set at $P < .05$.

Findings

Of 45 participants in each group, three patients from the intervention group and one patient from the control group left the study because of discharge from the hospital and/or their decline to participate, respectively (Figure 1).

As shown in Table 1, most participants in the intervention and control groups were males (97.6% in the intervention group and 90.9% in the control group). The mean (SD) age in the intervention and control groups was 44.30 (13.16) and 42.56 (14.50), respectively. Most types of inguinal hernia were indirect with a prevalence of 81% in the intervention group and 75% in the control group. No statistically significant differences between the groups in terms of gender, age, and type of inguinal hernia were reported ($P > .05$).

Table 2 shows the mean score and SD of pain intensity in the four stages of measurement in both intervention and control groups. The mean score of pain severity in all stages was significantly lower in the intervention than in the control group ($P < .001$). Also, the pain severity in the control group decreased over time, whereas in the intervention group, the pain increased 2 hours after the surgery, and after that, pain severity decreased.

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Table 1
The Characteristics of Participants in the Study and Comparison of Those in the Intervention Group With the Participants in the Control Group

Variables	Intervention Group ($n = 42$)	Control Group ($n = 44$)	P
Gender, n (%)			
Men	41 (97.6)	40 (90.9)	.18*
Women	1 (2.4)	4 (9.1)	
Age, M (SD)	44.30 (13.16)	42.56 (14.50)	.56†
Type of inguinal hernia, n (%)			
Direct inguinal	8 (19)	11 (25)	.50‡
Indirect inguinal	34 (81)	33 (75)	

n, number; M, mean.
* Fisher exact test.
† Independent-samples t test.
‡ χ^2 test.

The results of repeated-measures analysis of variance are shown in Table 3. The Mauchly's sphericity test ($df = 5$; $\chi^2 = 40.22$; $P = .001$) did not confirm the presumption of the covariance matrix sphericity. Therefore, the Huynh-Feldt test was used. It revealed statistically significant differences in four stages of measurements within the groups when compared 0 minutes after being transferred to the surgery ward, and 2, 6, and 24 hours after surgery ($P < .001$) (Figure 2).

Multiple Bonferroni comparisons in four time frames revealed that pain severity exhibited statistically significant differences within groups 0 minutes after being transferred to the surgery ward and 6 hours after surgery (mean difference [MD] = 1.76; 95% CI = 0.97 to 2.56; $P < .001$), and 24 hours after surgery (MD = 3.22; 95% CI = 2.52 to 3.93; $P < .001$). Also, statistically significant differences in pain severity between 2 hours after surgery and 6 hours after surgery (MD = 1.39; 95% CI = 0.82 to 1.96; $P < .001$) and 24 hours after surgery (MD = 2.86; 95% CI = 2.37 to 3.34; $P < .001$) were observed. However, no statistically significant differences were shown in pain between 0 minutes after being transferred to the surgery ward and 2 hours after the intervention (MD = 0.368; 95% CI = −0.31 to 1.05; $P = .89$). Furthermore, patients in the intervention group did not report any side effects or dissatisfaction related to aromatherapy using lavender essential oil during the study period.

Discussion

This study aimed to investigate the effects of inhalation aromatherapy with lavender essential oil on postoperative pain after inguinal hernia surgery. Pain is one of the most prevalent postoperative complaints in patients, and its appropriate management is one of the most important challenges in the process of taking care of patients undergoing surgery. Results suggested a positive effect of aromatherapy via inhalation of lavender essential oil on the reduction of postoperative pain in patients undergoing inguinal hernia surgery.

The researchers could not find any published research about the effect of aromatherapy on postoperative pain in hernia surgery, but previous studies indicate the analgesic effect of aromatherapy via inhalation of lavender oil in different surgeries. Two studies concluded that inhalation aromatherapy using lavender essential oil was an effective and secure complementary therapy for the reduction of pain after the cesarean section.[19,31] Ziyaeifard et al[32] also indicated that lavender essential oil inhalation significantly decreased pain in patients undergoing coronary angiography. In addition, another study suggested that lavender essential oil aromatherapy can be applied as a complementary method in relieving sternotomy pain in patients who have undergone coronary artery bypass graft surgery.[27] Similarly, the study by Seifi et al[21] showed that inhalation aromatherapy using lavender essential oil relieves the pain of patients in the first days after coronary artery bypass surgery.

Furthermore, the analgesic effect of aromatherapy using lavender inhalation on different types of acute pain was investigated in previous studies. Bikmoradi et al[10] conducted a quasi-experimental study to assess the effect of aromatherapy via lavender inhalation on pain associated with intravenous catheter insertion in preschool children and showed that lavender aromatherapy resulted in a significant reduction of the mean score of pain. Another study of the effect of inhalation of lavender essential oil on needle insertion pain revealed that aromatherapy decreased pain severity.[20] Also, Taşan et al[33] suggested that lavender oil inhalation decreased pain severity during vascular access in patients undergoing hemodialysis. Moreover, the findings of another study revealed that inhalation of lavender essential oil aromatherapy may be an effective therapeutic method in labor pain management.[34]

Conversely, the study conducted by Kim et al[35] of the pain-relieving effects of lavender essential oil aromatherapy in patients undergoing breast biopsy surgery showed no changes in perceived pain in the intervention group compared with the control group. Inconsistencies in results can be explained by the difference in the type of surgery, different pain severity levels, usage of various lavender essential oils (two drops of 2% lavender oil was used in the mentioned study), and so on. Also, the type of lavender species that essential oil was extracted from and the amount of intervention time could have had an effect on pain reduction, which was not addressed in the study. In addition, because the study by Kim et al and present study were performed in different countries, the individuals' culture profoundly influenced pain perception and pain tolerance.[36] In another study, the researchers evaluated the effects of lavender aromatherapy on pain and anxiety during intrauterine device insertion. According to this study, smelling lavender essential oil had no effect on pain intensity and only reduced anxiety in the intervention group.[37] The reason for such inconsistency can be the type of intervention and its duration. They used three drops of the lavender solution (diluted with milk) on cotton for inhalation,

Table 2
Comparison of Pain Severity Based on VAS Scale in Participants in the Intervention and Control Groups

Variables	Intervention Group, $n = 42$	Control Group, $n = 44$	df	t	P*
	Mean (SD)				
Intensity of pain after surgery					
0 min after being transferred to the surgery ward	3.59 (2.66)	7.93 (1.43)	84	9.44	<.001
2 h after surgery	3.90 (1.57)	6.88 (1.75)	84	8.28	<.001
6 h after surgery	2.88 (1.71)	5.11 (1.80)	84	5.87	<.001
24 h after surgery	1.52 (1.58)	3.54 (1.35)	84	6.37	<.001

VAS, visual analog scale.
* Independent-samples t test.

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Table 3
The Results of Repeated-Measures ANOVA for Comparison of the Severity of Pain Within the Groups

Sources	Sum of Squares	*df*	Mean Squares	*F*	Effect Size	*P*[*]
Sphericity assumed	557.84	3	185.94	80.09	0.488	<.001
Greenhouse-Geisser	557.84	2.26	246.83	80.09	0.488	<.001
Huynh-Feldt	557.84	2.35	237.04	80.09	0.488	<.001
Lower bound	557.84	1	557.84	80.09	0.488	<.001

ANOVA, analysis of variance.
[*] Repeated-measures ANOVA.

and the duration of inhalation was 30 minutes. In the present study, inhalation time was 20 minutes, and lavender was added to pure distilled water in the humidifier of the oxygen flow meter. Previous research suggested that individuals should not be exposed to the unattenuated essence of the herb for more than 20 minutes because of the desensitization of the olfactory receptors.[38] Additionally, the results of the study by Salamati et al[39] indicated that the inhalation of lavender essential oil had no significant effect on the reduction of postoperative pain in patients undergoing open heart surgery. The cause for such inconsistency can be the difference in the amount of lavender essential oil (two drops of lavender essential oil 2%) and duration of the intervention (10 minutes).

The mechanism of pain reduction in aromatherapy with lavender is not fully understood.[27] It is believed that the analgesic effect of aromatherapy using lavender stimulates the limbic system, which then releases different neurotransmitters. The neurotransmitters are encephalin, endorphins, noradrenaline, and serotonin, which reduce the autonomic response to painful stimuli.[8,10] Also, the pleasant perfume of lavender stimulates limbic areas, triggers memories, and recalls specific events or feelings, which helps strengthen the analgesic effect.[21] Furthermore, the pleasant scents of aromatherapy can increase tidal volume and decrease the respiratory rate leading to the development of a deep and peaceful breathing pattern.[8] In aromatherapy using lavender, such a breathing pattern is another mechanism for the reduction of pain.[40] In addition, previous studies suggested that lavender contains linalool, ketone, and linalyl acetate. These constituents have sedative, pain-reducing, soporific, and anti-inflammatory effects.[32] Also, one of the ingredients of lavender essential oil is 1,8-cineol, which can block the generation of pain mediators, such as prostaglandins and leukotriene through preventing the metabolism of arachidonic acid.[41]

The effect of aromatherapy massage and topical use of lavender has also been examined in some studies. The study by Nasiri et al[42] showed that aromatherapy massage using lavender reduced pain in patients with knee osteoarthritis. In another study, lavender essential oil massage decreased primary dysmenorrhea.[43] Furthermore, a study of the effect of topical usage of lavender essential oil on the pain severity caused by the insertion of dialysis needles in hemodialysis patients showed that the intervention is a strategy for the reduction of moderate pain.[8]

Limitations

The present study had some limitations. First of all, the surgical procedure was performed by several different surgeons. However, the surgical procedure was the same in all subjects. Second, a small amount of lavender essential oil was used for inhalation aromatherapy. Third, the nature of intervention in this study made patient blinding difficult. Fourth, although the findings of this study are impressive, this could be a placebo effect in patients who received aromatherapy with lavender essential oil in combination with oxygen or a nocebo effect in patients who received just oxygen. Fifth, applying sweet almond oil as a carrier to dilute of the lavender

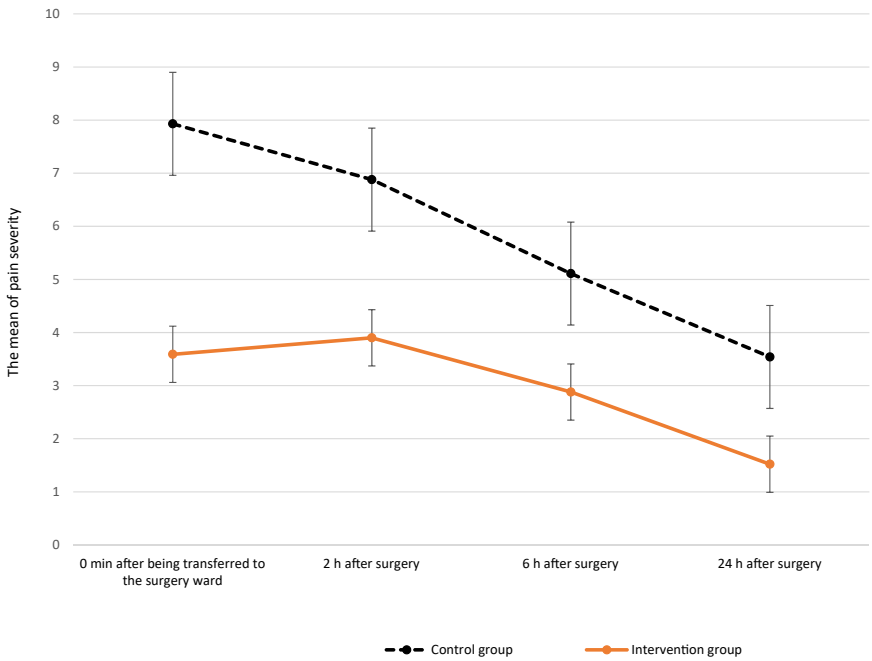

Figure 2. Pain severity according to the measurement stages in two study groups. This figure is available in color online at www.jopan.org.

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essential could affect study results as a confounding variable. Sixth, a single nurse could not take care of all the patients after surgery alone. Nevertheless, routine care for all patients was similar. Seventh, although the lavender essential oil was obtained from a reputable pharmaceutical company, gas chromatography-mass spectrometry testing has not been performed on the lavender essential oil used for inhalation aromatherapy, which can reduce the validity of results. Eighth, the patient's response to pain could potentially have been affected by their psychological conditions, exhaustion, and distress, which could not be controlled in this study. Finally, the results of this study cannot be generalized because most patients were middle-aged men.

Conclusion

Postoperative pain associated with inguinal hernia repair decreased in the intervention group after the inhalation of lavender essential oil when compared with the control group. Therefore, inhalation aromatherapy with lavender essential oil can be an effective therapeutic option for the management of postoperative pain in patients undergoing inguinal hernia surgery and can be used by nurses as a simple and safe strategy for pain relief. In the present study, only patients with inguinal hernia repair were examined. Therefore, further studies are needed to investigate the effect of inhalation aromatherapy on postoperative pain in other procedures. Also, in this study, only the essential oil of one species of lavender was used in a small amount; therefore, it is suggested that more studies should be carried out in this field using larger sample numbers and different amounts and species of lavender. Finally, given the major goal of pain management is improving postoperative function, future research is recommended considering postoperative functions, such as postoperative ambulation distance, length of hospital stay, and emergency room visits because of pain.

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