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The Effects of Aromatherapy With Clove and Lavender on Headache Caused by Spinal Anesthesia in Patients Undergoing Urological Surgery: A Randomized Clinical Trial Study

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ABSTRACT

Background and Aims: Headache is a common side effect of spinal anesthesia. Medicinal plants have been studied for their potential to relieve pain naturally. This study aimed to compare the effectiveness of clove and lavender aromatherapy in reducing headaches caused by spinal anesthesia in patients undergoing urological surgery.

Methods: This randomized clinical trial study involved 90 patients undergoing urological surgery at Bahonar Hospital in Kerman in 2021. Participants were selected using a convenience sampling method and randomly divided into intervention and control groups. The intervention group received aromatherapy with clove and lavender essential oils, while the control group received standard care. The effectiveness of aromatherapy in reducing post-operative headaches was measured using the Visual Analog Scale. Data analysis was performed using SPSS25.

Results: The study found that, while both lavender and clove aromatherapy reduced headache severity compared to the control group at 8 and 24 h post-surgery, the difference was not statistically significant ($p > 0.05$). However, a significant reduction in headache severity was observed in all three groups, with lavender and clove groups showing a greater reduction than the control group ($p < 0.001$).

Conclusion: Aromatherapy could be a simple, affordable, and safe way to reduce pain and the need for post-surgical sedatives. Due to conflicting results in previous studies, further research is necessary to confirm its effectiveness.

Trial Registration: IRCT20211124053172N1.

1 | Introduction

Spinal anesthesia is a common choice for certain surgeries due to its advantages over general anesthesia. It involves injecting a local anesthetic into the spinal canal to numb the lower body [1]. However, a common side effect is post-dural puncture headache, which typically occurs 1–2 days after the procedure. This headache is often worse when sitting or standing up and is caused by the leakage of cerebrospinal fluid through a small hole in the dura, the tough membrane surrounding the spinal

cord [2–4]. The severity of this headache can vary widely, and it can negatively impact a patient's emotional state and recovery process [5–7].

While there are treatments for post-dural puncture headache, they often do not completely eliminate the pain. Various preventive measures have been tried, but their effectiveness, especially with medications, remains uncertain [8]. Additionally, sedatives can have significant side effects and may not be effective for everyone. Given these limitations, it is essential to explore new and more effective ways to manage and prevent headaches after spinal anesthesia [9].

Complementary and alternative medicine, including herbal remedies, is increasingly used to address various health conditions [10]. Medicinal plants, rich in natural pain-relieving compounds, have been used for centuries to promote healing and biological balance, preventing the accumulation of medicinal substances in the body. Aromatherapy, a specific form of complementary medicine, is gaining popularity as a non-drug approach to managing various health issues, including pain [11, 12]. Aromatherapy works by inhaling essential oils, which are then absorbed and processed by the limbic system, a brain region associated with emotions and memory. This can trigger physiological responses that affect bodily systems, including the nervous, endocrine, and immune systems [13]. Inhalation is the most common method of aromatherapy, and it can stimulate the release of endorphins, natural pain relievers [14]. Lavender, a well-known medicinal plant, is often used in aromatherapy for its pain-relieving and anti-inflammatory properties. Studies have shown that lavender can be effective in reducing pain in various conditions, such as post-surgical pain and chronic pain [15–17].

Clove, another medicinal plant, is rich in eugenol, a compound with potent antioxidant, analgesic, anti-inflammatory, and antimicrobial properties. Clove bud oil, in particular, contains high concentrations of eugenol [18]. Research has shown that clove extract can effectively reduce pain in various conditions, including knee osteoarthritis, labor pain, and pain associated with medical procedures like hemodialysis [19–21].

Given the increasing popularity of complementary and alternative medicine, including aromatherapy, and the potential benefits of medicinal plants like lavender and clove, this study aimed to investigate their effectiveness in reducing post-spinal anesthesia headaches. No prior research has explored the specific impact of these essential oils on this particular type of pain. By comparing the effects of lavender and clove aromatherapy to standard care, this study sought to determine if these natural remedies could offer a safe and effective alternative or supplement to traditional pain management strategies.

2 | Materials and Methods

2.1 | Study Design and Setting

This randomized clinical trial study was conducted at the Urology Department of Bahonar Hospital in Kerman, a specialized center for post-urological surgery care. The hospital's large patient volume facilitated the selection and recruitment of participants for the study.

2.2 | Sample Size and Sampling

This study used convenience sampling to select participants who met specific criteria, such as age between 18 and 60 years, no prior history of spinal anesthesia, ASA I or II, absence of blindness and deafness that would impede the use of a visual analog scale, no history of migraine or chronic headache, no allergy to aromatic substances, no history of respiratory diseases such as asthma, sinus disorders, or rhinitis, no use of aromatherapy within 1 week prior to the intervention, no mental or psychological problems diagnosed by a physician, anesthesia performed by the same anesthesiologist using the same needle type and size with only one attempt, and no coagulopathy. Participants were excluded if they had a history of spinal anesthesia, required general anesthesia, were on strict bed rest, had allergies, experienced pre-operative headaches, or were pregnant. Eligible participants were randomly assigned to one of three groups: lavender aromatherapy, clove aromatherapy, or a control group. The block randomization method was used to ensure equal distribution of participants across the groups, considering factors like gender and age. To determine the appropriate sample size, the researchers analyzed previous studies and used a statistical formula. Considering factors like desired confidence level, statistical power, and variability in pain scores, they calculated that 26 participants per group would be needed. To account for potential dropouts, they enrolled 30 participants in each group.

2.3 | Data Collection Tool

Data collection was performed using a questionnaire comprising two parts: a demographic and background information form, and the Visual Analog Scale (VAS).

(A) The demographic and background information form included the participant's code, age, sex, marital status, level of education, date of admission to the urology department, operation date, and clinical information such as addiction, presence of underlying diseases, including digestive disorders, diabetes, and hypertension, medications taken by the patient (narcotics, sedatives), amount of fluids consumed before, during, and after the operation (within 24 h), anesthesia classification, duration of surgery, type of operation, and the number of sedatives administered, including pethidine, morphine, acetaminophen suppository, diclofenac suppository, acetaminophen tablet, APOTEL, and other drugs.

(B) The VAS is a simple and effective tool for measuring pain intensity. It consists of a 10-cm line, with one end representing no pain and the other representing the worst possible pain. Patients mark a point on the line to indicate their current pain level. This method is easy for patients to understand and use, making it a reliable tool for assessing pain. Compared to more complex pain scales like the McGill Pain Questionnaire, the VAS has been shown to be a suitable choice for measuring pain intensity in various clinical settings, including post-surgical pain [10].

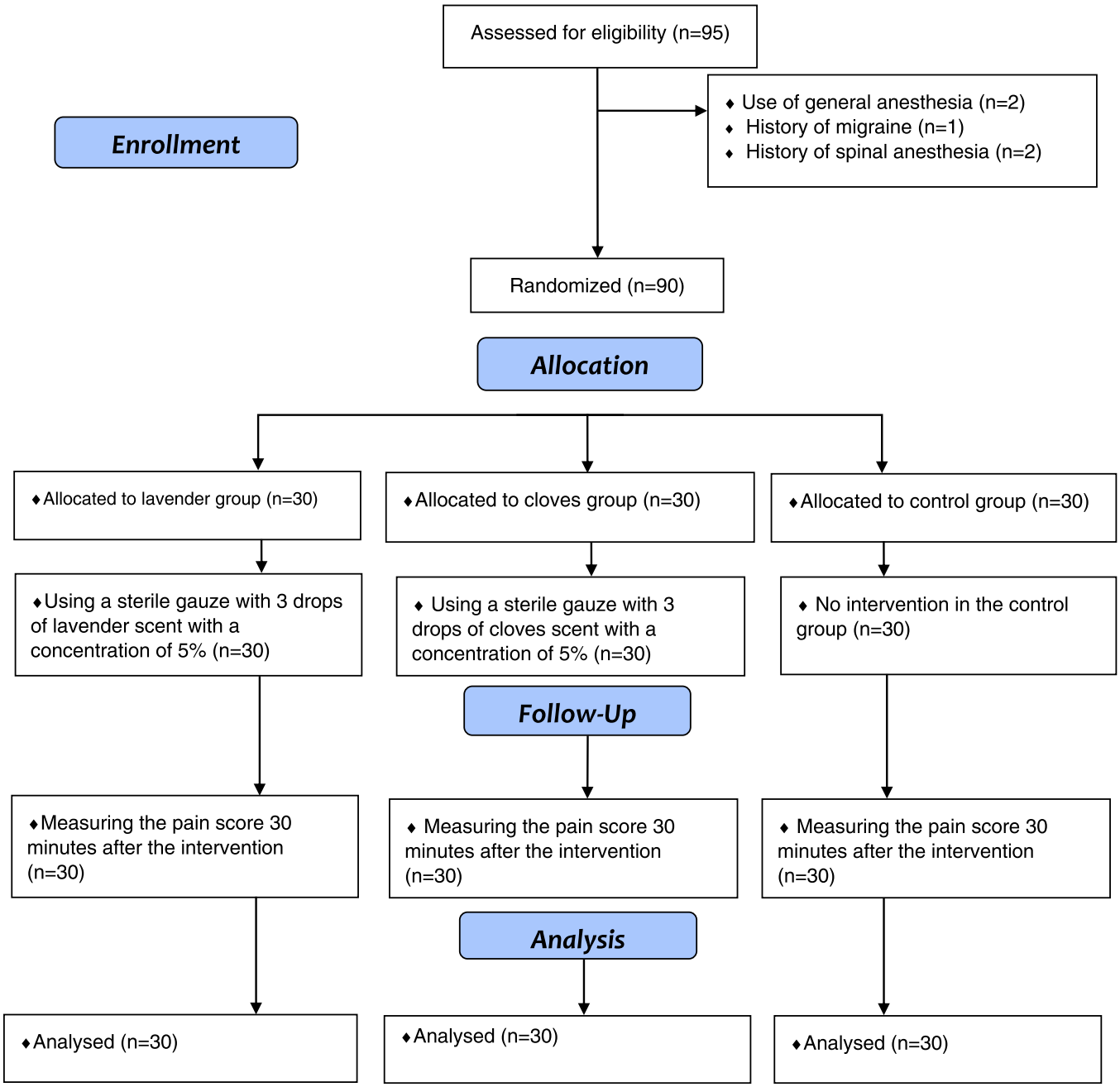

FIGURE 1 | Flow diagram of the study progress.

2.4 | Data Collection

To conduct the study, the researchers obtained ethical approval from the ethics committee and permission from the hospital and urology department. After obtaining informed consent from patients, demographic information was collected from medical records or patient interviews. Eligible patients were then randomly assigned to one of three groups using a block randomization method, which ensured balanced group sizes based on factors like gender and age. After surgery, patients were transferred to the recovery room where their initial pain scores were recorded using the VAS. The intervention groups received a specific essential oil: either lavender (*Lavandula angustifolia*) or clove (*Syzygium aromaticum*) sourced from a reputable company (Barid Essence) known for its quality control. The essential oils were diluted with ethanol to 5% concentration (https://barijessence.com). Patients inhaled the aroma from a sterile gauze pad placed 10 cm away from their nose for 5 min. This process was repeated 8 and 24 h after surgery in the urology department, with pain scores measured 30 min after each subsequent intervention. The control group received a gauze pad with normal saline and routine care, and the pain level was measured and recorded 8 and 24 h after the operation. All medications received by the patients in intervention and control groups were recorded 24 h after the operation. To ensure consistency, all groups were exposed to similar environmental conditions, such as noise levels and odors. The intervention groups were kept in separate rooms to prevent cross-contamination of scents (Figure 1).

2.5 | Data Analysis

Data analysis was performed using SPSS25. Descriptive statistics such as frequency, percentage, mean, and standard deviation were used to describe the demographic and background characteristics of the research units in the three groups. The chi-square test and analysis of variance (ANOVA) were used to compare demographic and background information. The Kruskal–Wallis test was used to compare the mean pain scores among the three groups.

2.6 | Ethical Considerations

This study was conducted in accordance with ethical guidelines (IRKMU.REC.1400.495) set by Kerman University of Medical Sciences. It was also registered as a clinical trial (IRCT2021 1124053172N1). Before participating, all individuals were fully informed about the study's goals and potential outcomes, and provided written consent. Participants could withdraw from the study at any time. Their privacy was protected, and their participation or non-participation would not impact their treatment. Upon study completion, the findings were shared with appropriate authorities as needed.

3 | Results

The mean ages of participants in the control, lavender, and clove groups were 42.83 ± 13.90, 43.77 ± 12.01, and 42.87 ± 13.35, respectively. Most of the participants in all groups were married men. While most of the participants in the control and clove groups had lower/upper secondary education, those in the lavender group had a diploma or higher education. The majority of patients were unemployed and had no history of addiction, smoking, or underlying disease. Statistical analysis showed no significant difference in these variables between the three groups ($p > 0.05$) (Table 1).

The study results revealed that the mean fluid intake was similar across all three groups before surgery. However, during surgery, the lavender group consumed significantly more fluid than the control and clove groups. After surgery, the control group consumed significantly more fluid than the lavender and clove groups. The ANOVA test results showed no significant difference in the amount of fluid consumed by the three groups before and during the operation ($p > 0.05$). The mean fluid intake was significantly different between the three groups after surgery. The control group consumed the most fluid, followed by the lavender group, and then the clove group ($p = 0.003$). The study results indicated no significant difference in length of hospital stay, anesthesia classification, narcotics and sedatives between the three groups 24 h after the operation ($p > 0.05$) (Table 2).

Table 3 indicates that before surgery, the mean headache scores in the control, lavender, and clove groups were 2.27 ± 1.98, 1.73 ± 1.76, and 1.37 ± 1.79, respectively. Eight hours after surgery, the mean headache scores in the control, lavender, and clove groups were 0.80 ± 1.42, 0.80 ± 0.10, and 0.60 ± 1.66, respectively. Twenty-four hour after surgery, the mean headache scores in the control, lavender, and clove groups were 0.57 ± 1.28, 0.30 ± 0.47, and 0.23 ± 0.59, respectively. Although the mean headache score in the lavender and clove groups was lower than that in the control group 8 and 24 h after the intervention, the Kruskal–Wallis test indicated that this difference was not statistically significant ($p > 0.05$). However, the mean headache score significantly decreased in all three groups ($p < 0.001$). Furthermore, the decrease in the mean headache score was more significant in the lavender and clove groups compared to the control group.

4 | Discussion

This study compared the effects of clove and lavender aromatherapy on headaches caused by spinal anesthesia in patients undergoing urological surgery. While both aromatherapy groups experienced a greater reduction in headache scores compared to the control group, these differences were not statistically significant. Nevertheless, a notable decrease in headache intensity was observed across all groups, with the aromatherapy groups showing a more substantial reduction. No prior research has specifically examined the effects of clove and lavender aromatherapy on post-urological surgery headaches. Previous studies exploring the efficacy of these essential oils in pain management for various surgical procedures, such as discectomy, tonsillectomy, percutaneous nephrolithotomy, and open-heart surgery, yielded mixed results. Some studies found no significant pain reduction with aromatherapy, aligning with the findings of this study [21–24]. Despite the lack of statistically significant differences, the clinical significance of aromatherapy in managing post-surgical headaches cannot be overlooked.

Several studies have explored the potential pain-relieving effects of lavender and clove aromatherapy. For instance, Nasiri et al. observed a reduction in headache scores following dural puncture, with a significant difference in favor of lavender oil immediately post-intervention [25]. Additionally, Darzi et al. and Abbasijahromi et al. reported that lavender aromatherapy significantly reduced pain intensity in patients who underwent open heart surgery and gave birth compared to the placebo group [26, 27]. Ilter et al. and Kasar et al. demonstrated that lavender inhalation reduced post-injection pain in patients with myofascial pain syndrome and catheter-related pain in oncology patients [43, 44]. Ghadirian et al. and Bagheri et al. also found that lavender aromatherapy reduced pain after appendectomy and inguinal hernia surgery [28, 29]. Lastly, Jamshidi et al. and Pakseresht et al. reported significant reductions in the severity and frequency of dialysis headache and cesarean section pain, respectively, through lavender aromatherapy [30, 31].

Dehghan et al. showed that clove extract significantly alleviated pain symptoms in patients with early-stage knee osteoarthritis [42]. Ozgoli et al. reported that clove was more effective than mint in reducing labor pain [19]. Maghboola et al. found that clove extract was effective in reducing pain during fistula needle insertion in patients undergoing hemodialysis [20].

TABLE 1 | Comparison of demographic and background variables in patients undergoing urological surgery in Bahonar Hospital, Kerman in 2021.

	Control		Lavender		Clove		Statistical test	
Group variable	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**		***p*-value**
Age	42.83	13.90	43.77	12.01	42.87	13.35	$F^{a} = 0.05$	0.95
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Statistical test	*p*-value
Female	14	46.7	13	43.3	11	36.7	$\chi^2 = 0.64^{b}$	0.73
Male	16	53.3	17	56.7	19	63.3		
Marital status								
Married	24	80	27	90	26	86.7	$\chi^2 = 1.26$	0.53
Single	6	20	3	10	4	13.3		
Education								
Lower/upper secondary	20	66.7	13	44.8	17	56.7	$\chi^2 = 2.86$	0.24
Diploma/higher	10	33.3	16	55.2	13	43.3		
Employment								
Employed	8	26.7	4	13.3	6	20	$\chi^2 = 4.31$	0.64
Unemployed	10	33.3	14	46.7	11	36.7		
Self-employed	8	26.7	11	36.7	10	33.3		
Retired	4	13.3	1	3.3	3	10		
History of addiction								
Yes	7	23.3	7	23.3	6	20	$\chi^2 = 0.13$	0.94
No	23	76.7	23	76.7	24	80		
History of smoking								
Yes	4	13.3	6	20	3	10	$\chi^2 = 1.26$	0.53
No	26	86.7	24	80	27	90		
History of underlying disease								
Cardiac disease								
No	27	90	28	93.3	28	93.3	$\chi^2 = 0.31$	0.86
Yes	3	10	2	6.7	2	6.7		
Pulmonary disease								
No	28	93.3	27	90	25	83.3	$\chi^2 = 1.58$	0.46
Yes	2	6.7	3	10	5	16.7		
Diabetes								
No	26	86.7	29	96.7	29	96.7	$\chi^2 = 3.21$	0.2
Yes	4	13.3	1	3.3	1	3.3		
HTN								
No	23	79.3	25	83.3	27	90	$\chi^2 = 1.30$	0.52
Yes	6	20.7	5	16.7	3	10		
Thyroid problems								
No	26	86.7	27	90	27	90	$\chi^2 = 0.22$	0.89
Yes	4	13.3	3	10	3	10		

[a]ANOVA test.
[b]Chi-square test,

Two systematic reviews concluded that aromatherapy with essential oils of lavender, orange, tea tree, lemon, sage, and *C. aurantium* may potentially reduce complications of hemodialysis, including painful injection and headache, chronic knee and neck pain, labor pain, episiotomy and post-cesarean pain, and acute knee and back pain [32, 33]. While these studies differ statistically from the present study, they align in demonstrating a positive effect of aromatherapy on pain. The

TABLE 2 | Comparison of clinical information related to surgery in patients undergoing urological surgery in Bahonar Hospital, Kerman in 2021.

	Control		Lavender		Clove		Statistical test	*p*-value
Group variable	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**		
The amount of fluid consumed before surgery	275.00	80.68	233.33	87.43	291.67	120.40	$F = 2.84$[b]	0.06
The amount of fluid consumed during operation	994.33	188.13	1110.00	230.96	1006.67	216.45	$F = 2.60$	0.08
The amount of fluid consumed after operation	340.00	124.15	295.00	106.15	236.67	110.59	$F = 6.21$	0.003
Duration of surgery	59	19.23	55.17	18.55	56.33	18.38	$F = 0.33$	0.72
Length of hospital stay (h)	25.60	6.09	24.80	4.38	24.00	0.00	$F = 1.02$	0.36
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Statistical test	*p*-value
Anesthesia classification								
1	24	80	24	80	26	86.7	$\chi^2 = 0.61$[c]	0.74
2–3	6	20	6	20	4	13.3		
Narcotics and sedatives received 24 h after surgery								
Dexamethasone								
Yes	4	13.8	2	6.7	1	3.3	$\chi^2 = 2.32$	0.31
No	25	86.2	28	93.3	29	96.7		
APOTEL								
Yes	20	66.7	19	63.3	14	46.7	$\chi^2 = 2.84$	0.24
No	10	33.3	11	36.7	16	53.3		
Pethidine								
Yes	16	53.3	18	60	12	40	$\chi^2 = 2.49$	0.29
No	14	46.7	12	40	18	60		
Ketorolac 30								
Yes	5	16.7	6	20	3	10	$\chi^2 = 1.18$	0.55
No	25	83.3	24	80	27	90		
Diclofenac								
Yes	4	13.3	3	10	2	6.7	$\chi^2 = 0.74$	0.69
No	26	86.7	27	90	28	93.3		
Type of surgery								
Tul	17	63	22	73.3	24	82.8	$\chi^2 = 8.90$	0.18
Tur	3	11.1	5	16.7	1	3.4		
Varico	4	14.8	1	3.3	1	3.4		
Others[a]	6	11.1	2	6.7	4	10.3		

[a] Prostate, biopsy, cystoscopy, hernia.
[b] ANOVA test.
[c] Chi-square test.

inconsistency in results may be attributed to various factors, including differences in surgical type, research population, pain intensity, and aromatherapy application methods (type, dose, and duration). Additionally, cultural differences and individual attitudes towards aromatherapy may influence outcomes. Howard and Hughes suggested that participants' attitudes toward aromatherapy could strongly influence the results [34]. Therefore, conducting multiple high-quality studies in this field can lead to more accurate and reliable results.

While the exact mechanisms of pain reduction in lavender aromatherapy are not fully understood, several theories have been

TABLE 3 | Comparison of the mean scores of headaches caused by spinal anesthesia in patients undergoing urological surgery before, 8 and 24 h after the intervention.

	Control		Lavender		Clove			
Group variable	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Kruskal–Wallis test**	***p*-value**
Before surgery	2.27	1.98	1.73	1.76	1.37	1.79	0.85	0.36
8 h after surgery	0.80	1.42	0.80	0.10	0.60	1.16	1.66	0.2
24 h after surgery	0.57	1.28	0.30	0.47	0.23	0.59	1.05	0.31
Friedman test	24.33		30.14		26.00			
p-value	< 0.001		< 0.001		< 0.001			

proposed [35]. Lavender aromatherapy stimulates the limbic system, triggering the release of various neurotransmitters, including encephalin, endorphin, noradrenaline, and serotonin, which can reduce pain perception [36]. The pleasant aroma of lavender can trigger memories and emotions, potentially distracting from pain and enhancing the analgesic effect [37]. Lavender's soothing scent can induce relaxation by promoting deep, slow breathing through increased tidal volume and decreased respiratory rate [38, 39]. Lavender contains linalool, ketones, linalyl acetate, and 1, 8-cineole, which have sedative, pain-reducing, hypnotic, anti-inflammatory, and potentially analgesic properties [24]. Linalool and linalyl acetate may stimulate the parasympathetic nervous system, while 1,8-cineole can inhibit the production of pain mediators like prostaglandins and leukotrienes [28].

Clove essential oil contains eugenol, a flavonoid compound known for its antioxidant, analgesic, and anti-inflammatory properties. Other compounds found in clove essential oil include carbophyllin, alcohol, benzylic compounds, demethyl benzoate, furfurol, and ethylene [40]. Eugenol, the primary active component, exhibits analgesic effects through several mechanisms [41]. Flavonoids also inhibit N-methyl-D-aspartate receptors, reducing intracellular calcium levels and decreasing the activity of nitrite oxide synthesizing enzymes and calcium-dependent phospholipase A2, both of which are involved in pain signaling [19].

The present study had some limitations. First, relying on self-reported pain assessments can be subjective and influenced by individual pain thresholds and cultural factors. Second, the presence of other types of pain, along with the inability to eliminate sedatives due to ethical considerations, might have confounded the results. Future studies could focus on patients who undergo spinal anesthesia and experience less pain other than headache. Additionally, combining clove aromatherapy with massage therapy could potentially enhance pain relief through synergistic effects.

5 | Conclusion

While this study did not find a statistically significant difference in pain reduction between the lavender, clove, and control groups, it did observe a noticeable decrease in pain intensity across all groups. Notably, the lavender and clove groups experienced a greater reduction in pain compared to the control group. Pain management is essential for not only pain relief but also for reduction of pain-related complications, frequent requests for opioid analgesics, and length of hospital stay. Severe pain can also have negative effects on patient recovery and increase the risk of subsequent problems such as cardiovascular diseases. Aromatherapy is a safe, inexpensive, and non-invasive alternative for reducing pain and the need for sedatives after surgery. Although conflicting results in different studies may raise questions, further research is necessary to obtain better and more accurate results. A combination of conventional and complementary therapies, like aromatherapy, can contribute to improved patient comfort and overall well-being.

Author Contributions

Mahlagha Dehghan: conceptualization, formal analysis, supervision, writing–review and editing, validation, methodology. **Atena Samareh Fekri:** conceptualization, methodology, data curation, investigation, writing–original draft, writing–review and editing. **Niloofar Rashidipour:** methodology, data curation, writing–original draft. **Naeimeh Naeimi Bafghi:** methodology, validation, supervision, writing–original draft. **Ali Maghfouri:** investigation, methodology, writing–original draft. **Mohamadreza Ebadzadeh:** supervision, methodology, writing–review and editing.

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Consent

The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Transparency Statement

The lead author Atena Samareh Fekri affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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