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Research Paper

The effect of inhalation aromatherapy of geranium on pain and physiological indices after appendectomy: A double-blind randomized clinical trial

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ABSTRACT

Introduction: The aim of the present study was to evaluate the effect of inhalation aromatherapy with sweet-scented geranium essential oil on pain and physiological indices after appendectomy.
Methods: This double-blind clinical trial was performed on 120 patients undergoing appendectomy. Aromatherapy was performed with 1% sweet-scented geranium and sweet almond oil in the experimental placebo groups, respectively. Physiological symptoms were recorded before induction of anesthesia, before surgery, 30 min and 4 h after surgery. The control group received no intervention and only pain intensity and physiological indices were recorded in the mentioned stages. The placebo group underwent sweet almond essential oil aromatherapy. Data collection tools included demographic information form, physiological index checklist, and visual pain scale.
Results: Results of 7 measurements showed significant differences between the experimental and placebo groups as well as the experimental and control groups in terms of mean heart rate, systolic and diastolic blood pressure, blood oxygen percentage, and pain ($P < 0.001$).
Conclusion: Results of the present study showed that the effect of inhalation aromatherapy with sweet-scented geranium essential oil after appendectomy reduces pain and physiological indices. Therefore, the above aromatherapy can be used as a complementary treatment along with other treatments.

1. Introduction

Annually, hundreds of millions of people undergo surgery around the world [1]. Acute appendicitis is the most common cause of acute abdomen and surgery, so that 7% of people need appendectomy during their lifetime due to acute appendicitis [2]. The prevalence of acute appendicitis has increased in recent years, and, 9.4 out of 10,000 people currently develop acute appendicitis in 2019 [3]. The male-female ratio of acute appendicitis cases is 1.3–1. The maximum prevalence occurs among males aged 15–25 years, and the risk of developing appendicitis during the lifetime of a man and woman is 8.6% and 6.7%, respectively [2]. If patients with acute appendicitis don't undergo appendectomy surgery in a timely manner, blackening and rupture of the appendix wall tissue will occur, which can lead to dangerous consequences such as sepsis and even death [4]. Surgery and anesthesia cause physiological disorders. Responses to stress and surgical injury include the secretion of cortisol, catecholamines, cytokinesis, ADH, and glucagon. Some metabolic responses and hormonal response to surgery cause an imbalance of important physiological functions, resulting in postoperative complications including pain, changes in body temperature, instability of hemodynamic indices, restlessness, delirium, nausea, vomiting, and etc. [5]. The American pain society refers to pain as the fifth most vital sign [6]. Physiological assessment is a method of pain assessment that directly and objectively determines the pain experience as a neurophysiological activity [7]. Physiological scales include heart rate, blood pressure, respiration rate per minute, and blood oxygen percentage [8].

Postoperative pain is the most unwanted complication of surgery and is experienced by all patients [9]. Studies show that 30% of patients suffer from postoperative mild, moderate, and pain in 30%, 30%, and 40% of cases, respectively [10]. Overall, surgery and

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postoperative pain cause changes in the respiratory system. Painful surgical incision leads to increased reflex muscle tone during inhalation and exhalation and decreased diaphragmatic function, resulting in decreased pulmonary capacity and inability to breathe deeply or cough effectively, and, in some cases, hypoxia, hypercapnia, secretion retention, atelectasis, and pneumonia. Other postoperative pain complications include increased blood pressure and heart rate, myocardial ischemia or arrhythmias, endocrine disorders, ileus, nausea and vomiting, increased deep vein thrombosis, anxiety, discomfort, and insomnia that delay the patient's recovery [11]. Methods of stabilizing physiological indices include the use of pharmacological and non-pharmacological methods [12]. Medications often have side effects such as hypotension, weakening of vital functions such as respiration and heart rate, drowsiness, nausea and vomiting, constipation and sometimes allergic reactions and even shock. In addition to numerous physical and mental complications, physical dependence, and tolerance to pain medication impose high health costs on the healthcare system of countries [13].

In recent years, non-pharmacological methods have attracted the attention of patients and healthcare providers known as complementary therapies or complementary medicine [14]. Clinical aromatherapy is the controlled use of essential oils or aromatic oils of plants for therapeutic purposes and is highly regarded today. This method is one of the complementary treatments used along with conventional therapies to ameliorate or treat diseases. Two common methods include inhalation aromatherapy and massage aromatherapy. Aromatherapy refers to the use of essential oils or aromas extracted from aromatic plants for therapeutic purposes [15]. With regard to inhalation aromatherapy, olfactory receptors convert odors into nerve impulses and send them to the limbic system. Previous researches revealed that aromatherapy triggers emotions such as pleasure, anger, anxiety and rage, which affect heart rate, blood pressure, respiration, brainwave activity and the release of hormones regulating insulin levels, body temperature, stress, metabolism, and hunger. Since the limbic system also affects the nervous system, odors can stimulate and release neurotransmitters and endorphins in the brain, inducing a sense of well-being [16]. One of the essential oils used in aromatherapy is sweet-scented geranium. Sweet-scented geranium is a plant from the geraniaceae family [17]. The essential oil of this plant contains geraniol, citronellol, terpineol, and alcohols [18], which have anti-inflammatory, analgesic, antioxidant, anti-cancer, and antimicrobial effects [19]. Considering the role of nursing staff in controlling pain and postoperative complications in patients, members of the treatment team and especially nurses can use these methods in the prevention and treatment of complications with appropriate training. Considering that there has been no study on effect of aromatherapy on physiological indices and pain reduction, the present study aimed to investigate effect of inhalation aromatherapy with sweet-scented geranium essential oil on pain intensity and physiological indices as an objective finding of pain after appendectomy and if the preferred method is found, it can be recommended for use in a wide range of patients undergoing surgery.

2. Methods

2.1. Participants

This double-blind clinical trial study was performed on 120 patients undergoing appendectomy referred to an educational hospital in the city of Neishabour in central Iran from December 1, 2018 to June 10, 2019. Inclusion criteria included having consent to participate in the study, open appendectomy, surgery with general anesthesia, postoperative consciousness, absence of cognitive or psychological disorders, patients with ASA I and ASA II, patients aged 15 to 45, no drug addiction, surgical procedures lasting less than one hour, and having no NGT. Exclusion criteria included the occurrence of any unforeseen complication during the intervention that prevents the researches from continuing to work with the patient, such as severe hypotension and other complications that make it difficult for patients to continue undergoing the intervention, the patient's refusal to participate in the intervention. The sample size was estimated 108 people (n = 36 per group) according to the data of similar studies [20] with 95% confidence interval, and 80% test power. Considering the possible drop-out rate, the sample size was increased by 10%, the total sample size was estimated to be 120 people.

2.2. Intervention

After coordination with the hospital administration, the objectives of the study were first explained to the patients. The patients completed the consent form and entered the study voluntarily. Then, a total of 120 patients who were selected using convenience sampling were randomly assigned to three groups using block randomization (by randomizing participants within blocks such that an equal number are assigned to each group) in three groups: aromatherapy with sweet-scented geranium essential oil (intervention) (n = 40), aromatherapy with sweet almond (placebo group) (n = 40), and control group (n = 40). The block size of 6 was used in the present study. In the present study, similar drug intake and anesthesia procedure (propofol, atracurium, fentanyl, midazolam, isoflurane, N2O) were used in the three groups. The intervention was performed by assessing pain intensity and physiological indices through a questionnaire before transferring the patient to the operating room. In intervention group (aromatherapy with sweet-scented geranium) three drops of 1% sweet-scented geranium essential oil (Barij Essence Pharmaceutical Company) were poured on a pad and patients were asked to inhale it for 5 min from the 10 cm distance. Pain were recorded t1 (before induction of anesthesia in operation room), t2 (when the patient enters recovery in the first time that the patient is able to respond), t3 (when leaving the recovery), and t4 (4 h after surgery) in three groups. Physiological indices were recorded t1 (Before entering the operating room), t2 (before induction of anesthesia), t3 (before the operation), t4 (after the completion of the operation), t5 (after entering the recovery), t6 (immediately after the second intervention), t7 (before leaving the recovery), and t8 (4 h after surgery) in three groups.

The patient underwent aromatherapy with sweet-scented geranium essential oil for 5 min for the second time. Then, pain intensity and physiological indices were measured immediately after the intervention and when the patient left the recovery room (30 min after the patient entered the recovery room), and 4 h after surgery. In the placebo group patients were underwent sweet almond inhalation aromatherapy. In the sweet almond aromatherapy group, three drops of sweet almond essential oil (Barij Essence Pharmaceutical Company) are poured on a pad and patients are asked to inhale it for 5 min from the 10 cm distance. Pain and physiological indices were measured in different time series similar to intervention group. In the control group, no intervention was performed and only the patients' pain intensity and physiological indices were measured and recorded during the above mentioned stages (Figs. 1 and 2).

2.3. Instrument

Data collection instrument is a three-part questionnaire including demographic information, visual analogue scale (VAS),

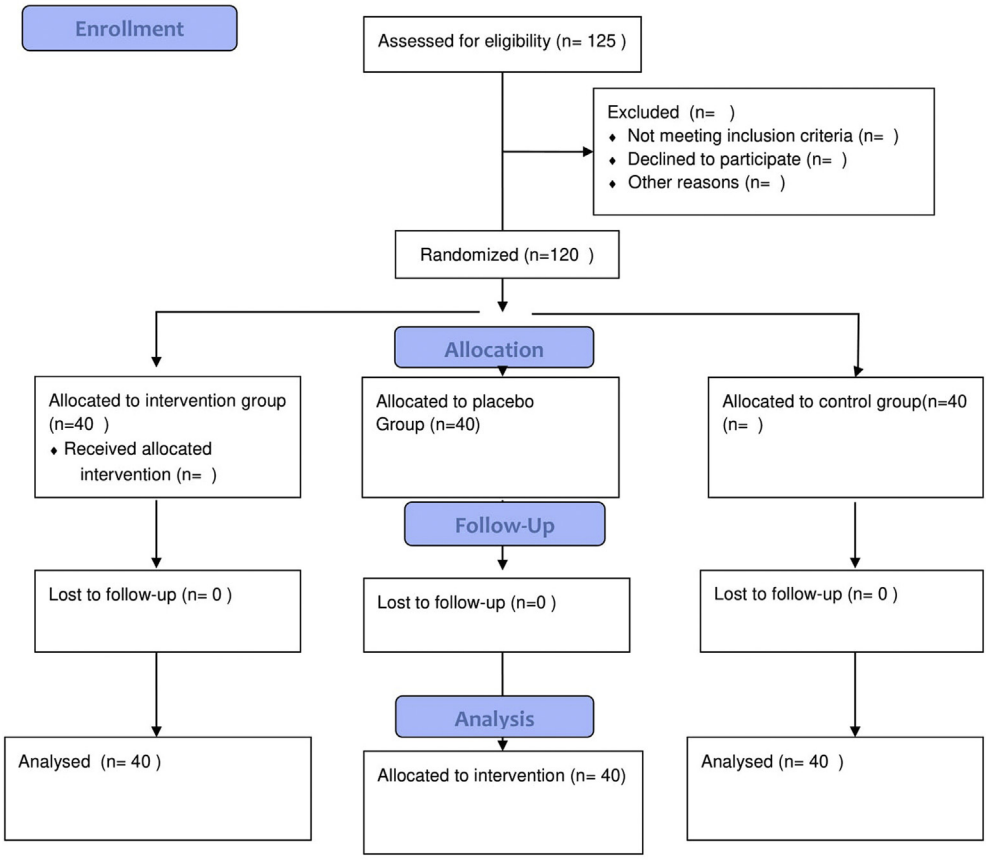

Fig. 1. CONSORT-2010 flow diagram.

and a form for collecting physiological indices information. To measure pain, a standard ten-point VAS was used as a standard tool for self-reporting pain. The possible pain intensity score range is with 0 (no pain) to 10 (the worst pain).

Physiological indices (blood pressure, heart rate, respiratory rate and blood oxygen percentage) were measured using finger pulse oximeter and portable monitoring device (Pooyandegan Rah-e Saadat Co. Iran). Parallel forms reliability was used to determine the reliability of the device. To this end, Physiological indices were measured simultaneously using a mercury sphygmomanometer by touching radial artery pulse for 60 s every morning and the results were compared. A form for recording personal information and physiological indices has an acceptable validity and reliability and completed by the researcher.

2.4. Ethical considerations

The present study has been approved by the Ethics Committee of Neishabour University of Medical Sciences with the Ethic code: IR.NUMS.REC.1397.018. The study protocol registered in.

Iranian Registry of Clinical Trials (IRCT) under number IRCT20170131032329N2. Written informed consent was obtained and the patients were given the right to participate in the intervention and to withdraw from it at any stage.

2.5. Statistical analysis

SPSS Version 22.0 for Windows (SPSS Inc., Chicago, IL, USA) was used to data analyze. Descriptive and interpretive statistical tests were used to data analysis. Data analysis was performed using repeated measure ANOVA, chi-square the mean, percentage and standard deviation. Confidence interval of 95% and a significance level of *P*-value less than 0.05 was considered significant.

3. Results

A total of 120 eligible individuals were included in the study and none of them were excluded from the study, therefore, the final analysis was performed on 120 subjects. A total of 50.4% of the participants were male and 49.6% were female. The mean age of participants was 24 ± 6 years and 23 ± 5, 23 ± 4 and 25 ± 8 years in the intervention, placebo, and control groups, respectively. Other information of the participants is presented in Table 1 (Table 1).

Results of 7 measurements showed a significant difference between the three groups in terms of mean heart rate before and after the first intervention ($p < 0.001$). However, there was no significant difference between the experimental group and placebo in terms of post-intervention mean heart rate ($P < 0.2$), but this difference was significant between the experimental and control groups ($p < 0.001$).

Results of 7 measurements showed a significant difference between the three groups in terms of mean systolic blood pressure before and after the first intervention ($p < 0.001$). There was a significant difference between the experimental and placebo as well as the experimental and control groups in terms of the mean systolic blood pressure after the intervention ($p < 0.001$).

Results of 7 measurements showed a significant difference between the three groups in terms of diastolic blood pressure before the intervention and after the first intervention ($p < 0.001$). There was a significant difference between the experimental and placebo as well as the experimental and control groups in terms of mean diastolic blood pressure after the intervention ($p < 0.001$).

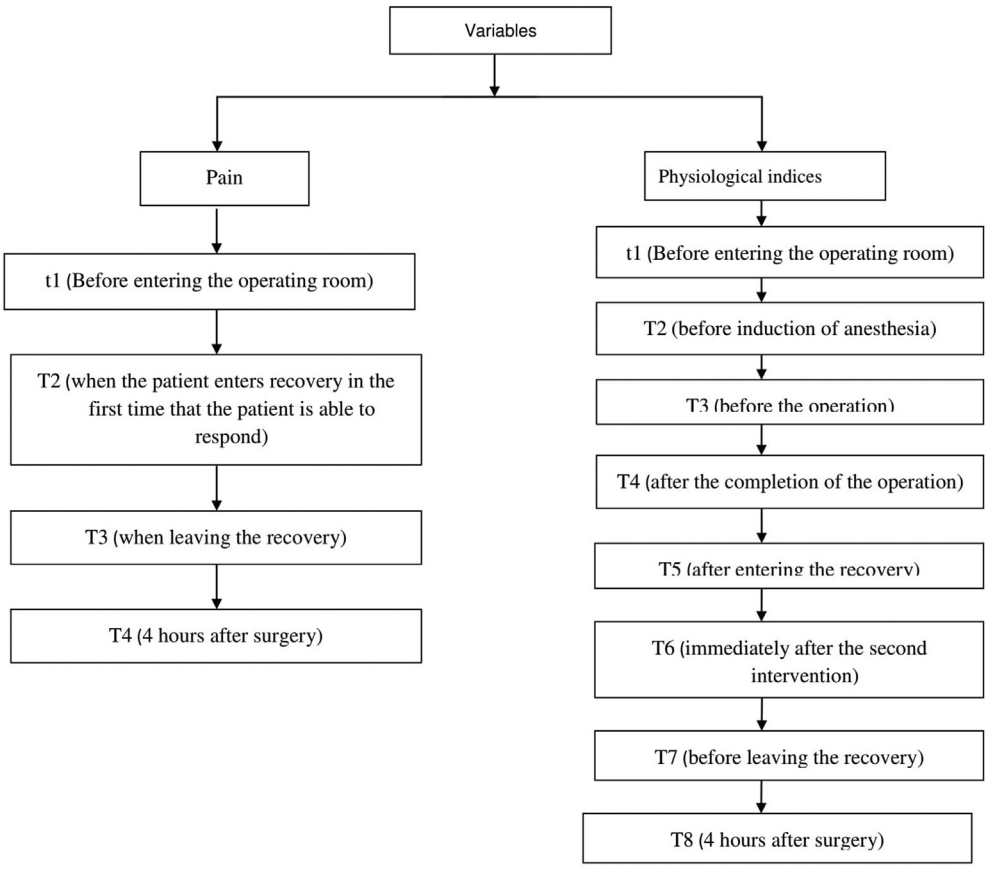

Fig. 2. Measurement stages of pain and physiological indices.

Table 1
Demographic characteristics of participants.

	Intervention	Placebo	Control	p-value
Age (SD)	23.1 (5)	23.6 (4.4)	25.4 (8.3)	0.2
Gender				0.4
Male	21 (58.3)	18 (48.6)	18 (45)	
Female	15 (41.7)	19 (51.4)	22 (55)	
Education				0.6
Illiterate	1 (2.8)	1 (2.7)	3 (7.5)	
Under diploma	14 (38.9)	16 (43.2)	20 (50)	
Diploma	12 (33.3)	12 (32.4)	7 (17.5)	
University education	9 (25)	8 (21.6)	10 (25)	
Job				0.1
Employ	3 (8.3)	0	3 (7.5)	
Self-employ	9 (25)	13 (35.1)	11 (27.5)	
Jobless	2 (5.6)	8 (21.6)	7 (17.5)	
Housewife	7 (19.4)	6 (16.2)	11 (27.5)	
Student	15 (41.7)	10 (27)	8 (20)	
Residence				0.01
County	11 (30.6)	5 (13.5)	18 (45)	
City	13 (36.1)	20 (54.1)	8 (20)	
Rural	12 (33.3)	12 (32.4)	14 (35)	
BMI(SD)	21.8 (4.1)	21.2 (3.4)	22.9 (3)	0.09
History of surgery				0.1
Yes	14 (38.9)	12 (32.4)	7 (17.5)	
No	22 (61.1)	25 (67.6)	33 (82.5)	
Duration of surgery	30 (6.9)	28.2 (5.5)	31.1 (7.4)	0.1
Use of analgesic				0.001
Yes	10 (27.8)	28 (75.8)	25 (62.5)	
No	26 (72.2)	9 (24.3)	15 (37.5)	
HR time1 (SD)	75.3 (10)	71.3 (6.67)	75.6 (5.71)	0.02
Sys time1 (SD)	114.83 (9.76)	116.02 (10.99)	109.65 (9.22)	0.01
Dia time1 (SD)	74.41 (7.18)	73.83 (8.07)	67.35 (7.41)	0.001
Spo time1 (SD)	97.22 (0.89)	96.24 (1.62)	96.9 (0.92)	0.002
Pain time1 (SD)	5.44 (1.18)	5.59 (1.03)	6.62 (1.16)	<0.001

Results of 7 measurements showed a significant difference between the three groups in terms of the blood oxygen percentage before the intervention and after the intervention ($p < 0.001$). There was a significant difference between the experimental and placebo groups ($p < 0.001$) as well as the experimental and control groups ($p = 0.005$) in terms of the mean blood oxygen percentage after the intervention.

Results of 4 measurements showed a significant difference between the three groups in terms of pain intensity before and after intervention ($p < 0.001$). There was a significant difference between the experimental and placebo groups as well as the experimental and control groups in terms of the mean pain level ($p < 0.001$) (Table 2).

4. Discussion

The findings of the present study showed that sweet-scented geranium essential oil inhalation aromatherapy significantly reduces pain and physiological indices after appendectomy. Results of 7 measurements showed a significant reduction in mean heart rate, systolic blood pressure, diastolic blood pressure, arterial blood oxygen saturation percentage, and pain showed significant reduction in sweet-scented geranium essential oil and sweet almond essential oil groups before and after the intervention.

In a study of the effect of lavender inhalation on hemodynamic indices at the time of sheet extraction in patients after cardiac angiography, Pourmirzaei et al. (2016) measured hemodynamic indices of patients before, during, 10 min and 20 min after aromatherapy. The results of studies showed that lavender extract inhalation can reduce hemodynamic indices when

Table 2
Comparison of physiologic indexes before and after intervention in three groups.

		p-value	Control	Placebo	Intervention	Time
HR	First intervention	<0.001	81.25 (5.9)	77.8 (6.1)	73.5 (9.7)	Time2
			81.52 (5.73)	77.89 (6.58)	74.5 (9.91)	Time3
			81.52 (5.73)	78.54 (6.95)	73.36 (9.83)	Time4
	Second intervention	<0.001	81.52 (5.73)	75.4 (7.19)	73.58 (9.58)	Time5
			78.75 (5.88)	75.35 (7.07)	73.38 (9.46)	Time6
			78.75 (5.88)	75.27 (6.46)	73.63 (9.14)	Time7
			80.12 (5.81)	69.56 (5.96)	74.11 (9.41)	Time8
SYS	First intervention	<0.001	102.1 (7.3)	96.78 (7.93)	111.66 (9.9)	Time2
			101.87 (7.19)	97.27 (7.95)	108.25 (10.04)	Time3
			102.75 (7.49)	98.35 (9.81)	109.05 (9.42)	Time4
	Second intervention	<0.01	102.75 (7.49)	103.48 (7.66)	110.27 (8.86)	Time5
			104.3 (7.78)	103.29 (7.65)	110.27 (8.86)	Time6
			104.3 (7.78)	105.4 (7.44)	111.41 (8.5)	Time7
			106.55 (7.47)	110.37 (8.74)	111.44 (8.34)	Time8
DIA	First intervention	<0.001	65.22 (4.83)	64.48 (6.48)	74.97 (7.24)	Time2
			65.6 (4.73)	63.98 (6.72)	74.97 (7.24)	Time3
			65.7 (4.71)	64.35 (6.21)	74.19 (6.5)	Time4
	Second intervention	<0.01	66.52 (4.55)	67.08 (6.07)	74.83 (7.12)	Time5
			66.42 (4.62)	66.4 (5.79)	73.61 (6.58)	Time6
			66.22 (4.54)	68 (6.1)	74.27 (5.84)	Time7
			66.9 (4.51)	73.37 (6.21)	74.02 (5.89)	Time8
SPO2	First intervention	0.1	97.8 (0.72)	97.59 (0.86)	97.86 (0.63)	Time2
			97.85 (0.62)	97.81 (0.61)	98.08 (0.36)	Time3
			97.85 (0.62)	97.27 (1.12)	97.47 (0.81)	Time4
	Second intervention	<0.001	96.37 (0.62)	98.97 (0.79)	96.75 (0.84)	Time5
			96.37 (0.62)	95.86 (0.75)	97.72 (0.51)	Time6
			96.37 (0.62)	96.24 (1.21)	97.5 (0.56)	Time7
			97.3 (0.96)	96.27 (1.62)	97 (0.71)	Time8
pain	Second intervention	<0.001	5.65 (0.73)	4.67 (1.1)	4.67 (1.1)	Time5
			4.77 (0.61)	4.54 (1.04)	4.54 (1.04)	Time6
			4.82 (0.67)	4.56 (1.04)	4.56 (1.04)	Time7
			4.67 (61)	3.24 (1.4)	3.24 (1.4)	Time8

removing the sheet in patients after angiography [21]. In a study by Yadegari et al. (2017), 2 drops of jasmine essential oil and 2 drops of distilled water were poured on the collar of patients' shirts in the intervention and control groups, respectively and were inhalation for 1 h. Before and after the intervention, physiological variables, including systolic and diastolic blood pressure, pulse and respiration rate were measured and recorded. The results showed that jasmine essential oil had an effect on physiological indices before laparotomy in general surgery wards [22]. In the study by Beikmoradi et al. (2016) the experimental group (n = 30 children) inhaled 5 drops of 2% lavender essential oil and the control group (n = 30 children) inhaled 5 drops of distilled water as a placebo for 20 min before entering the venipuncture room. Physiological indices were measured 30 min before, 5, and 10 min after venous catheter placement. They showed significant difference between the experimental and control groups in terms of mean heart rate (P = 0.001) arterial blood oxygen saturation percentage (P = 0.003), and respiratory rate (P = 0.001) before, immediately, 5 and 10 min after placement of the venous catheter [23].

In the study of effect of aromatherapy and relaxation on physiological indices and anxiety of patients undergoing coronary angiography, Tahmasebi et al. (2013) found a significant difference between relaxation and control groups as well as aromatherapy and control groups in terms of mean anxiety level. However, the results did not show a statistically significant difference between the relaxation and aromatherapy groups after the intervention. The variables of systolic blood pressure, pulse rate, and respiration rate were significantly lower in the aromatherapy and relaxation group compared to the control group [24]. The results of these studies are consistent with the results of the present study.

In a study of the effect of aromatherapy (lavender essential oil) on pain after discectomy surgery, Arjomand et al. showed that lavender essential oil aromatherapy was not effective on pain intensity after discectomy surgery in the experimental group within the first hours. It is recommended to use the above effective method in the case of acute moderate- and low-intensity pain [25]. The difference between the results of this study and the results of the present study may have been due to the type of study and the use of other aromatherapy methods.

In a study of the effect of sweet-scented geranium aromatherapy on postoperative pain intensity in hospitalized children, Sirousfard (2013) showed no significant difference between the two groups in terms of the pain intensity score before intervention. After initiating aromatherapy and 12 h after entering the ward, the pain intensity score in the sweet-scented geranium group decreased more significantly than the placebo group [26], which is consistent with the results of the present study. It should be noted that sweet-scented geranium aromatherapy has not been used in surgeries carry out on adult people in the mentioned studies. One of the strengths of the present study was the evaluation of the effect of sweet-scented geranium extract aromatherapy in two stages, which increase the authenticity of results and increases the generalizability of the results.

One of the limitations of the present study is disregarding of the relationship between odors with emotions and past experiences the odors. Considering that there has been no study on the effect on muscle relaxation and aromatherapy on physiological indices of patients after appendectomy based on searches carried out in the relevant databases, Therefore, it is recommended to carry out further studies with a larger sample size in this area. It is hoped that the present research provides the conditions for a broader and

more comprehensive assessment of the studied variables and improvement of hemodynamic status of patients following appendectomy.

5. Conclusion

Sweet-scented geranium essential oil inhalation aromatherapy significantly reduces pain and physiological indices after appendectomy. Considering the long-term use of painkillers after surgery and subsequent complications, and considering that aromatherapy is uncomplicated r has fewer complications, this method can be used to relieve pain, stabilize physic logical indices, providing better care, and promotion of postoperative care among appendectomy patients.

Ethical approval

The present study has been approved by the Ethics Committee of Neyshabour University of Medical Sciences with the Ethic code: IR.NUMS.REC.1397.018. The study protocol registered in Iranian Registry of Clinical Trials (IRCT) under number IRCT20170131032329N2.

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Author contribution

Dr. Akram Gazerani and Mahnaz Abavisani: conceptualized and designed the study, drafted the initial manuscript, and reviewed and revised the manuscript.

Mrs. Zohreh Sarchahi, and Ms Sara Sadat Hosseini: Designed the data collection instruments, collected data, carried out the initial analyses, and reviewed and revised the manuscript.

Conflict of interest statement

None declared.

Guarantor

Mahnaz Abavisani.

Research Registration number

Name of the registry: Iranian Registry of Clinical Trials (IRCT).

Unique Identifying number or registration ID: IRCT20170131032329N2.

Hyperlink to the registration (must be publicly accessible): https://en.irct.ir/trial/33655.

Consent

Approved.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijso.2020.12.004.

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