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The effect of aromatherapy using Lavender (*Lavandula angustifolia* Miller) and *Citrus aurantium L.* extracts to treat anxiety of patients undergoing laparoscopic cholecystectomy: A randomized clinical trial in Iran

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Abstract

Introduction: Nowadays, complementary medicine such as aromatherapy has an important application in medicine, particularly in treating anxiety. The objective of the present study was to compare the effects of aromatherapy using lavender (*Lavandula angustifolia* Miller) and *Citrus aurantium L.* extracts on the anxiety level of patients undergoing laparoscopic cholecystectomy at Shiraz University of Medical Sciences Training Hospital in Iran. **Methods:** This Randomized Clinical Trial (RCT) was carried out in 2017 on a total of 90 patients undergoing laparoscopic cholecystectomy using aromatherapy. The subjects were randomly assigned to 3 groups based on the inclusion and exclusion criteria using sampling methods based on the goals. Two groups received either aromatherapy with *Lavandula angustifolia* Miller extract, aromatherapy with *Citrus aurantium L.* extract. The third group (control) received a placebo (odorless oil). The aromatherapy was performed on all subjects for 20 minutes. Patient anxiety was assessed using a Spielberg questionnaire before and after applying the aromatherapy intervention. The data obtained were analyzed by SPSS software via Chi-square test, one-tailed variance analysis, Tukey, t-tests, and Kruskal-Wallis test.

Results: State and trait anxiety decreased for the aromatherapy groups, compared to control group, after applying the aromatherapy (P<0.001); moreover, there was an increased severity of anxiety in the control group (P<0.05). Indeed, the effects of aromatherapy with *Lavandula angustifolia* Miller and *Citrus aurantium L.* extracts were observed and confirmed; both extracts significantly decreased the severity of anxiety in the trial groups as compared to the control group (P<0.001). Moreover, the effect of aromatherapy with both of the aforementioned extracts was similar to each other. **Conclusion:** There was no significant difference between the lavender (*Lavandula angustifolia* Miller) and *Citrus aurantium L.* extracts in aromatherapy; therefore, either extract may be applied and useful in the clinic to alleviate preoperative anxiety.

Keywords

Introduction

Laparoscopic cholecystectomy is considered to be a gold standard procedure for gallbladder removal (Chhabra et al., 2016). Indeed, millions of people have undergone this type of surgery annually. Nonetheless, anxiety is an important problem for the majority of people who are candidates for this surgery since patients fear, for example, the outcome of their surgery and anesthesia (Sadati et al., 2013). Their pre-operative anxiety stimulates the sympathetic, parasympathetic and endocrine systems, which result in tachycardia, hypertension and cardiac stimulation, which might lead to arrhythmia. The development and long-term anxiety could result in protein denaturation, reduced wound healing, decline in body immunity reactions, increased infection risk, and electrolyte imbalance (Ghardashi et al., 2003).

Aromatherapy is a form of complementary medicine that has been predominantly embraced by most countries in recent years. This complementary medicine could result in olfactory system stimulation and induce relaxation, which might decrease or alleviate symptoms associated with anxiety (Steflitsch and Steflitsch, 2008). Lavender (*Lavandula angustifolia* Miller) extract can exert many effects including tranquilizing, anti-seizure and epileptic effects, as well as anti-anxiety, anti-pain and anti-addictive effects. It also has anti-inflammatory, apoptotic, mutative, and anti-cancerous effects; its neuro-protective effect is also considered as another benefit of aromatherapy. Therefore, this type of plant could be applied as a pharmacologic compound in the healthcare setting and specifically utilized in treating neurologic diseases (Ozgoli et al., 2013).

Several studies have evaluated aromatherapy with *Lavandula angustifolia* Miller extract as a non-invasive nursing intervention in different settings, such as anxiety improvement of patients who have undergone angiography and stenting, hemodialysis, dentistry and/or general surgeries, and decreasing cortisol concentration and cardiac parameters, including blood pressure and pulse rate (Chhabra et al., 2016). Other studies indicated insignificant effects of aromatherapy on preoperative anxiety in patients undergoing different types of surgery and those undergoing radiotherapy (Pimenta et al., 2016). In a systematic study performed by Lee *et al*. evaluating anti-anxiety effects of aromatherapy with lavender extract on patients with anxiety, no complications were reported (Lee et al., 2011).

The positively significant effects of *Citrus aurantium L.* extract on reducing the anxiety and physiological indices of patients with chronic myeloid leukemia were reported in a study by Franco *et al*. (Franco et al., 2016), which indicated that aromatherapy with lavender essence (odorless oil was a placebo) reduced the preoperative anxiety in breast surgery patients (Franco et al., 2016). The aromatherapy effect with *Lavandula angustifolia* Miller and *Citrus aurantium L.* essences on the severity of preoperative anxiety in patients undergoing laparoscopic cholecystectomy was not reported in our knowledge. Thus, the aim of the current study was to evaluate the effect of aromatherapy with *Lavandula angustifolia* Miller and *Citrus aurantium L.* extracts on the state anxiety of patients undergoing laparoscopic cholecystectomy in a randomized clinical trial study in Shiraz, Iran.

Materials-Methods

The current randomized clinical trial study was carried out in Shiraz, Iran to evaluate the effects of aromatherapy with *Lavandula angustifolia* Miller and *Citrus aurantium L.* essences on preoperative anxiety in patients referred to the training hospitals to undergo laparoscopic cholecystectomy. The subjects were assigned to 3 groups: control group (no aromatherapy), aromatherapy with *Lavandula angustifolia* Miller essence, and aromatherapy with *Citrus aurantium L.* essence. The male and female wards as well as waiting wards of the training hospitals included Shahid Faghihi, Namazi, Mother and Kid, and Shahid Rajaee Hospitals. A total of 90 male and female patients considered for laparoscopic cholecystectomy were randomly classified in the 3 equal groups (i.e. control, aromatherapy with *Lavandula angustifolia* Miller essence and *Citrus aurantium L.* essence groups).

The study was completed on 90 individuals based on a sample size formula with 95% confidence interval (Shabanian G, 2016). The patients meeting the inclusion criteria were enrolled in the study. Informed consent forms were obtained from each patient after explaining the goals of the study and after reassuring the study patients that their medical information would be kept confidential. The

demographic and Spielberg questionnaire forms were filled out with the help of the study researchers. The patients' basic preoperative anxiety was measured via the Spielberg questionnaire with the help of the study researchers. The subjects who acquired the mark 20 were allowed to be in the study. Afterwards, 2 drops of *Lavandula angustifolia* Miller and and 2 drops of *Citrus aurantium L.* essences (at 100% concentration for both) were poured on a tissue. The subject inhaled the tissue for 20 minutes from a 20-cm distance. For the intervention groups, 2 drops of placebo (odorless oil) were poured on a tissue for the control group; the subjects inhaled it for 20 minutes from a 20-cm distance. The patients' anxiety was measured and recorded again. The aforementioned essences used in the current study were produced by Gol Daroo Company, Iran. The essences were pureed and analyzed using Cooper Chromatography J.C.

The inclusion criteria were as follows: male and female patients over 40 years of age, patients undergoing laparoscopic cholecystectomy, the awake patients, and those not taking tranquilizers nor anti-anxiety or herbal medications. As well, these other criteria had to be met: lack of addiction to opioids (based on the patients' self-report), lack of occupancy in a health-care setting, lack of optical, olfactory and auditory problems, lack of acute problems, acquiring the mark 20, and having mild to moderate anxiety. The exclusion criteria included: acute pain during completion of questionnaire, inclination to prevent the study at every stage of intervention, patients with severe anxiety, and patients who underwent urgent cholecystectomy. The study was approved by the Research Deputy and Research Ethics Committee of Shiraz University of Medical Sciences in Iran. The present study was the result of a research project granted by Shiraz University of Medical Sciences and Health Care Services; the study was registered at the Iranian Registry for Clinical Trials (IRCT) as IRCT2017031433083N1.

The questions based on a 4-choice Likert scale which related the patient's state of anxiety as: "under no circumstances", "often", "generally", and "most of the time". The questions related to the anxiety trait were: "approximately never", "sometimes", "most of the time", and "approximately always" (Spielberger et al., 1970). The results obtained were analyzed using SPSS software version 16. The descriptive statistics (mean and standard deviation) were used to evaluate the specific objectives. A p-value <0.05 was considered to be statistically significant. The quantitative data normality for each group was assessed through Kolmogorov Smirnov test; parametric and non-parametric tests were also used. Therefore, the data obtained were analyzed using descriptive (frequency, percentage, mean, and standard deviation) and inductive (Chi-square, one-tailed variance (ANOVA test), Tukey and t-tests, and Kruskal-Wallis) statistics. The changes demonstrated in the patients' anxiety levels were compared via ANOVA and Tukey tests. The anxiety level was separately compared using t-test before and after applying the intervention.

Results

A total of 90 patients undergoing laparoscopic cholecystectomy were studied. They were assigned to 3 groups: control, aromatherapy with *Lavandula angustifolia* Miller essence, and aromatherapy with *Citrus aurantium L*. essence. The groups' demographic data are presented in **Table 1**. There was no significant difference in the 3 groups in terms of demographic data (P>0.05). The history of hospitalization was observed in 46 cases (51.1%). All of the patients had not undergone any surgery previously. There was no significant difference in demographic data for gender (P<1.00), marital status (P<0.952), educational status (P<0.976), occupancy (P<0.551), salary (P<0.786), and hospitalization (P<0.837) (**Table 2**).

Table 1. Patients' demographic data

Variable	Variable levels	Aromatherapy with *Lavandula angustifolia* Miller essence n (%)	Aromatherapy with *Citrus aurantium L.* n (%)	Control n (%)	Total n (%)	P-value
Gender	Male	(50)15	(50)15	(50)15	45(50)	P<1.00
	Female	(50)15	(50)15	(50)15	45(50)	
Marital status	Single	(7.36)11	(33.3)10	(66.7)20	31(34.1)	P<0.952
	Married	(63.3) 19	(66.7)20	(66.7)20	59(65.6)	
	Divorced	(0) 0	(0)0	(0) 0	(0)0	
Educational status	Under Diploma	(32.1)17	(34)18	(34) 18	53(58.9)	P<0.976
	Graduated with Diploma	7 (38/9)	6(33.3)	5(27.8)	18(20)	
	Higher than Diploma	(31.6) 6	6(31.6)	(36.8)7	19(21.1)	
Occupancy	Unemployed	(23.3)7	(13.3)4	(16.7)5	16(17.8)	P<0.551
	Employed	(3.33) 10	(46.7)14	(53.3)16	34(37.8)	
	Housewife	(3.43)13	(40)12	(30)9	34(37.8)	
Salary	Equality in salary and reimbursement	(30.6)15	(38.8)19	(30.6)15	49(54.4)	P<0.786
	Salary is higher than reimbursement	(41.2)7	(23.5)4	(53.3)6	17(18.9)	
	Salary is less than reimbursement	(33.3)8	(29.2)7	(37.5)9	24(26.7)	
With or without	Yes	(100) 30	(100)30	(100)30	90(100)	P<1.00

						P<1.00
without insurance	N0	(0) 0	(0) 0	(0) 0	(0) 0	
Hospitalization	Yes	(53.3)16	(53.3)16	(46.7)14	46(51.1)	P<0.837
	No	(46.7)14	(46.7)14	(53.3)16	44(48.9)	
Surgery history	Yes	0(0)	0(0)	0(0)	0(0)	P<1.00
	No	(100)30	(100)30	(100)30	(100)30	
Age	Mean	51.87	51.93	51.47	51.76	P<0.975
	Standard deviation	7.81	7.26	5.87	6.95	
	Confidence interval	48.95-54.79	54.65-49.22	49.27.66	45.32-53.72	

Mild anxiety and relative mild state anxiety was observed in 33.3% and 66.7%, respectively, of the patients who had undergone aromatherapy with *Lavandula angustifolia* Miller . Also, the mild and relative mild state anxiety were observed in 30% and 66.7% of the patients, respectively, who had undergone aromatherapy with *Citrus aurantium L*. The greatest frequency of relative mild state anxiety was observed in the control group (**Table 3**).

Table 2. Qualitative distribution of the studied units according to the state of anxiety in the three groups before and after the intervention

Anxiety	Groups					
	Control	Citrus aurantium	Lavender	Control	Citrus aurantium	Lavender
	Before Mean ±SD	After Mean ±SD	Before Mean ±SD	After Mean ±SD	Before Mean ±SD	After Mean ±SD
Mild Anxiety	6.7±2	33.3±10	13.4±4	33.3±10	23.3±7	23.3±7
Relatively Mild	60±18	66.7±20	66.7±20	66.7±20	60±18	60±18
Relatively Intense	33.3±10	0±0	20±6	0±0	16.7±5	16.7±5

The mild and relative mild anxiety traits were observed in 36.7% and 63.3%, respectively, of the patients who had undergone aromatherapy with *Lavandula angustifolia* Miller. The mild and relative mild anxiety trait were observed in 33.3% and 63.37% of the patients, respectively, who had undergone aromatherapy with *Citrus aurantium L.*. The greatest frequency of the relatively

mild anxiety trait was observed in the control group (**Table 4**). There was no significantly statistical difference between state and trait anxiety before and after applying the intervention in the study groups (**Table 4**). However, a significant statistical difference was observed in state and trait anxiety between aromatherapy and control group after applying the intervention.

Table 3. Distribution of the studied units based on the level of anxiety in the three groups before and after the intervention

Anxiety	Groups					
	Lavender		Citrus aurantium		Control	
	Before Mean ±SD	After Mean ±SD	Before Mean ±SD	After Mean ±SD	Before Mean ±SD	After Mean ±SD
Mild Anxiety	6.7±2	36.7±11	6.7±2	33.3±10	16.7±5	16.7±5
Relatively Mild	66.7±20	63.3±19	63.3±19	63.3±19	66.7±20	73.3±22
Relatively Intense	26.7±8	0±0	30±9	3.3±1	16.7±5	10±3

Table 4. Mean and standard deviation of anxiety levels in patients undergoing surgery in the three study groups

	Anxiety state						Anxiety trait					
	Aromatherapy with essential oils citrus aurantium		Aromatherapy with Lavender essential oils		Control		Aromatherapy with essential oils citrus aurantium		Aromatherapy with Lavender essential oils		Control	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Mean	43.90	30.17	43.90	31.10	39.70	40.70	45.33	34.90	43.47	34.20	40.03	40.53
SD	7.88	5.59	9.71	6.44	10.02	9.69	7.78	7.37	8.59	5.79	9.25	8.98
P-value	P<0.001		P<0.001		P=0.04		P<0.001		P<0.001		P=0.074	

The rate of state anxiety of patients increased in the control group preoperatively, which might due to filling out the questionnaire, while state and trait anxiety were decreased in both groups of aromatherapy, likely owing to the positive effects of aromatherapy (**Table 5**). There was a significantly statistical difference in the state and trait anxiety among the groups, before and after applying intervention, with regards to mean and standard deviation (P<0.05) (**Table 6**).

Table 5. Comparison of mean changes and standard deviation of state and trait anxiety of patients undergoing surgery in the three groups after intervention, compared to before intervention

Variable	Groups					
	Anxiety state			Anxiety trait		
	Aromatherapy With essential oils citrus aurantium	Aromatherapy With essential oils Lavender	Control	Aromatherapy With essential oils citrus aurantium	Aromatherapy With essential oils Lavender	Control
Changes in mean state and trait anxiety (group changes)	-13	-12.8	1	-10.43	-9.26	0.5
SD	3.78	4.21	2.58	2.37	4.25	1.47
Confidence interval	-14.41, -11.58	-14.37, -11.22	0.03,1.96	-11.31, -9.54	-10.85, -7.67	-0.5, 1.05
Result	P<0.001	P<0.01	P<0.0011	P<0.00	P<0.001	P<0.001

Table 6. Comparison of the mean differences in state anxiety and adjectives pre-surgical among the groups using Tukey's post-test

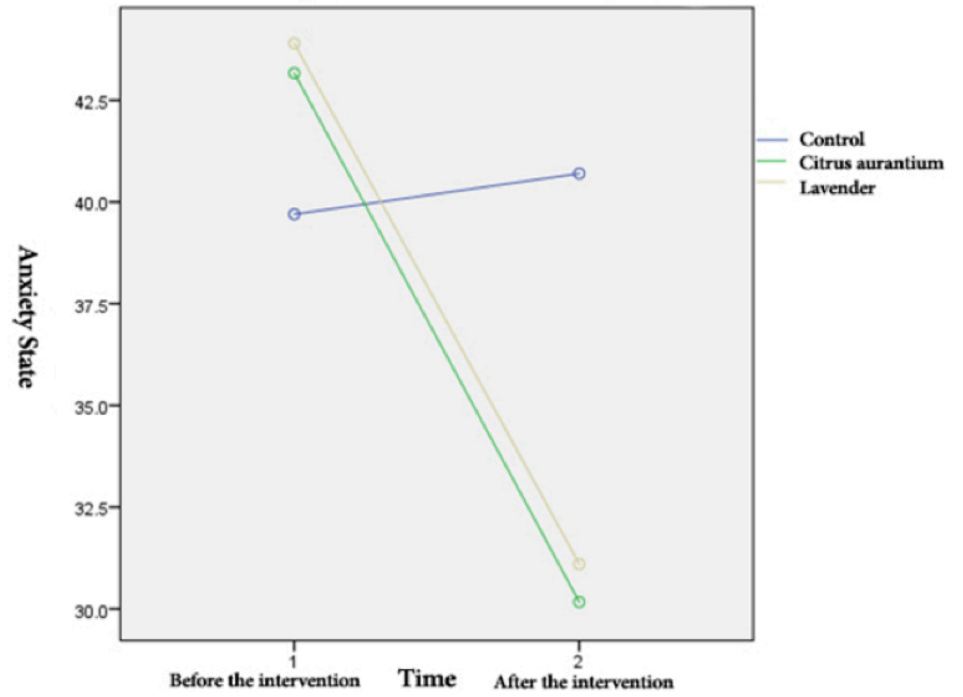| Variable	Groups					
	Anxiety state Mean±SD			Anxiety trait Mean±SD		
	Aromatherapy With essential oils citrus aurantium - Aromatherapy With essential Lavender oils	Control - Aromatherapy With essential citrus aurantium oils	Control - Aromatherapy With essential Lavender oils	Aromatherapy With essential citrus aurantium oils - Aromatherapy	Control - Aromatherapy With essential citrus aurantium oils	Control - Aromatherapy With essential Lavender oils
Mean Difference Group changes	-0.2	14	13.8	-1.1	10.9	9.7
SD	0.93	0.93	0.93	0.76	0.76	0.76
P-value	0.98	<0.001	<0.001	0.28	<0.001	<0.001

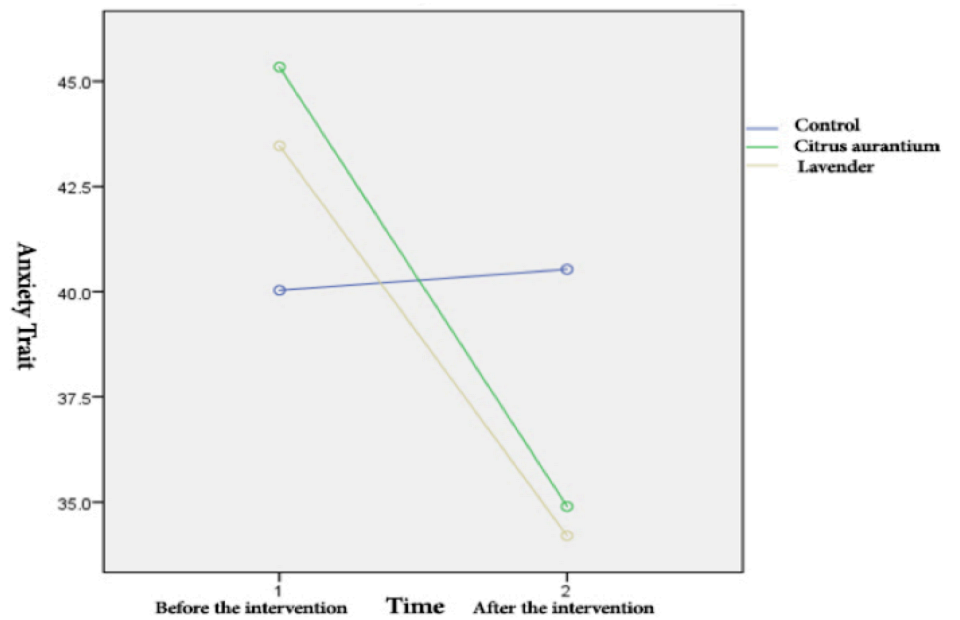**Figure 1.** Mean of state anxiety in the study groups.

Figure 2. Mean of trait anxiety in the study groups.

Based on Post Hoc test, there was a significantly statistical difference in state anxiety for aromatherapy with *Lavandula angustifolia* Miller versus *Citrus aurantium L.* essences (P=0.975), for control group versus aromatherapy with *Lavandula angustifolia* Miller (P<0.001), and for control group versus aromatherapy with *Citrus aurantium* L. (P<0.001). Moreover, there was a significantly statistical difference in trait anxiety for aromatherapy with *Lavandula angustifolia* Miller versus *Citrus aurantium L.* essences (P=0.278), for control group versus aromatherapy with *Lavandula angustifolia* Miller (P<0.001), and for control group versus aromatherapy with *Citrus aurantium* L. (P<0.001). Therefore, there was an overall significant difference in state and trait anxiety between aromatherapy with *Lavandula angustifolia* Miller essence versus control group, as well as aromatherapy with *Citrus aurantium L.* essence versus control group (**Fig. 1**).

The rate of state anxiety was increased in the control group but decreased after aromatherapy with *Lavender angustifolia* miller and *Citrus aurantium L.* essences, after applying the intervention (**Fig. 2**). The rate of trait anxiety was decreased after aromatherapy with *Lavandula angustifolia* Miller and *Citrus aurantium L.* essences, after applying the intervention, but no significant fluctuation was observed in the control group.

Discussion

Age is one of the main factors influencing anxiety (Lee et al., 2011). Reports indicate that evolutionary differences affect adults' adaptability to anxiety; many are embarrassed about their anxiety and/or deterred from seeking medical help due to high healthcare costs and long hospitalizations. The history of hospitalizing and acquiring information about experiences might affect patients' preoperative anxiety.

In this study, we evaluated anxiety of patients undergoing surgery (laparoscopic cholecystectomy). The results obtained indicated a significantly statistical difference (P=0.458) (Yim et al., 2009). According to a study by Muzzarelli *et al.* (Muzzarelli et al., 2006). the level of a patient's anxiety would be decreased if there was a satisfactory history of previous surgeries; lack of satisfaction or success in previous surgeries might increase a patient's anxiety (Kritsidima et al., 2010). Therefore, in this study, patients who had an unsatisfactory experience with surgery were excluded from the study.

Anxiety is an unpleasant feeling that may emerge in patients due to fear of illness, hospitalization, anesthesia, and/or surgery; thus, accordingly, physiological, behavioral and oriental symptoms are also evaluated (Fayazi et al., 2011). These symptoms are typically observed in 15-20% of clinical patients (Ghardashi et al., 2004). In this study, we evaluate the effects of aromatherapy

with *Lavandula angustifolia* Miller and *Citrus aurantium L.* essences on decreasing preoperative anxiety.

From comparing the patients' anxiety before and after application of aromatherapy (**Table 2**), we observed changes in anxiety level after the aromatherapy intervention (**Table 4**), with respect to state and trait anxiety, which showed a significantly statistical difference compared to control group (P<0.001). A remarkable difference in state anxiety was observed between aromatherapy with *Lavandula angustifolia* Miller and control, and between *Citrus aurantium L.* and control group (P<0.001). However, no significantly statistical difference was observed between aromatherapy with *Lavandula angustifolia* Miller and with *Citrus aurantium L.* essences (P=0.975). A remarkable difference in trait anxiety was observed between aromatherapy with *Lavandula angustifolia* Miller versus control, and *Citrus aurantium L.* versus control (P<0.001). These current findings show that aromatherapy with both *Lavandula angustifolia* Miller and *Citrus aurantium L.* essences can decrease anxiety levels.

In a previous study by Bakhsha *et al.* comparing aromatherapy with *Lavandula angustifolia* Miller versus *Citrus aurantium L.* essences to treat students' pretest anxiety, the authors found that the mean anxiety in those treated with *Lavandula angustifolia* Miller versus *Citrus aurantium L.* essences decreased from 5.67 to 3.90 and 5.25 to 2.97, respectively. The findings were statistically significant, compared to the control group (P<0.001) (Babashahi M, 2015). Indeed, the results of Bakhsha *et al.* study are in agreement with the current study's findings. Just like our study, there were two intervention groups in the study by Bakhsha *et al.* (Bakhsha F, 2016).

Franco *et al.* (Franco et al., 2016) performed a study to determine the effect of aromatherapy with *Lavandula angustifolia* Miller on preoperative anxiety of breast surgery patients in an outpatient ward. In their study, a total of 93 breast surgery patients met the inclusion criteria and were enrolled in the study. The participants were assigned to 2 groups, including aromatherapy with *Lavandula angustifolia* Miller aroma and control (odorless oil as placebo).

For the control and aromatherapy groups, no significant difference was observed in the results obtained from the Spielberg state anxiety questionnaire before aromatherapy. Both aromas decreased anxiety significantly in both groups. There was a significantly statistical improvement after aromatherapy (with *Lavandula angustifolia* Miller or *Citrus aurantium L.* extract) in reducing anxiety levels, but no remarkable change was observed in the vital signs of the individuals of the two aromatherapy groups. Moreover, there was a significant decline in anxiety level using aromatherapy with *Lavandula angustifolia* Miller versus odorless oil (placebo). The anxiety in those of the placebo group might due to having too much attention paid on them, according to a study by Franco *et al.* (Franco et al., 2016). Indeed, the results of the above study by Franco *et al.* (2016) are in agreement with our current study, except for the reduction of anxiety in their placebo group (Franco et al., 2016). The only questionnaire used

in their study was the Spielberg questionnaire, while both Spielberg State and Trait anxiety questionnaires were applied in our study.

Pimenta *et al.* conducted a study to evaluate the anti-anxiety effects of *Citrus aurantium L.* in patients with chronic myeloid leukemia (CML) (Pimenta et al., 2016). The anxiety and physiological indices decreased in the CML group receiving aromatherapy with *Citrus aurantium L.*; a considerable decrease was demonstrated in the CML group on chemotherapy (10 mg of Diazepam). The only physiological index to decline was Diastolic pressure; no significant change was observed in physiological indices nor was there a change in anxiety of the placebo group. Notably, there was a statistically significant difference in anxiety for the CML group on chemotherapy (Diazepam) and receiving aromatherapy (*Citrus aurantium L.*) versus the CML group on chemotherapy alone (Pimenta et al., 2016). Like our study, the subjects in their study were assigned to 3 groups (2 groups of intervention and a control); the results obtained in their study were compatible with the current study's findings.

In another study (Goes et al., 2012), researchers evaluated the effects of inhaling *Lavandula angustifolia* Miller aroma on anxiety in a total of 60 hospitalized patients with myocardial infarction. The patients were randomly assigned to 2 groups (intervention and control). In the intervention group, 3 drops of *Lavandula angustifolia* Miller essence were applied; in the control group, 3 drops of aqueous solution (placebo) were aliquoted onto a tissue and the subject inhaled it for 20-30 minutes, 3 times per day for 3 days. The Spielberg questionnaire was used in that study. The results obtained indicated a significantly statistical difference between state anxiety and trait anxiety before and after applying the intervention (P<0.001). Therefore, their study showed that *Lavandula angustifolia* Miller essence could reduce state and trait anxiety rates among patients with myocardial infarction (Lee et al., 2012). In the current study, 2 drops of *Lavandula angustifolia* Miller essence were used. However, the current study's findings are more in agreement with the study by Ganjloo *et al.* (2014). Some studies have also reported that aromatherapy with *Citrus aurantium L.* essence might significantly decrease anxiety levels (Leite et al., 2008).

In another study (Namazi M, 2014), researchers evaluated the effects of *Citrus aurantium L.* aroma on the severity of anxiety during the first stage of delivery (126 terms). It was reported that the aroma could decline the anxiety level, similar to our current study's findings. Conversely, researchers who assessed herbal aromas' effects on anxiety during preoperative delivery reported insignificant statistical differences before and after applying the aromatherapy intervention (Hur et al., 2005). Thus, their study was not in agreement with the current study's findings. Furthermore, Muzzarelli *et al.* also noted that aromatherapy with Lavandula angustifolia Miller aroma insignificantly decreased patient anxiety (Muzzarelli et al., 2006). Thus, it is advisable to conduct studies with larger sample size and to evaluate the effects of other types of essences on preoperative anxiety for different surgeries. As well, evaluating the effects of

aromatherapy on patients' hemodynamic indices immediately after anesthesia is suggested.

Conclusion

Overall, as reported in this study, the application of aromatherapy (*Lavandula angustifolia* Miller and *Citrus aurantium L.* aromas) can lead to decrease of anxiety in patients undergoing laparoscopic cholecystectomy. The significantly positive effects of aromatherapy were preoperatively observed and led to anxiety decline. In addition, aromatherapy with *Lavandula angustifolia* Miller and *Citrus aurantium L.* essences were equally effective at reducing patients' anxiety levels.

Abbreviations

CI: Confidence Interval
RCT: Randomized clinical trial
SD: Standard deviation

Acknowledgements

Author Contribution

Conceptualization: JE-AE-AH-ID; Data curation: ZKH EG; Formal analysis: ZKH; Funding acquisition: JE-AE-AH; Investigation: JE-AE; Methodology: JE-ZKH; Project administration: JE-AE-AH ; Resources: JE-AE-ZKH; Software: JE-ZKH-ID; Supervision: JE-AH ; Validation: JA-AE-AH ; Writing – original draft: AH-ZKH-ID; Writing – review & editing: JE-ZKH–AH

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