



Effect of inhalation aromatherapy with lavender essential oil on stress and vital signs in patients undergoing coronary artery bypass surgery: A single-blinded randomized clinical trial

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Summary

Objectives: At present, aromatherapy is used widely in medical research. This study aimed to investigate the effects of inhalation aromatherapy using lavender essential oil to reduce mental stress and improve the vital signs of patients after coronary artery bypass surgery (CABG).

Design: A single-blinded randomized controlled trial was conducted with 60 patients who had undergone CABG in a 2-day intervention that targeted stress reduction.

Participants: Sixty subjects following coronary artery bypass surgery in two aromatherapy and control groups.

Setting: The study was conducted in Ekbatan Therapeutic and Educational Center, Hamadan, Iran, in 2013.

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Interventions: On the second and third days after surgery, the aromatherapy group patients received two drops of 2% lavender essential oil for 20 min and the control group received two drops of distilled water as a placebo.

Main outcome measures: The primary outcome was mental stress, which was measured before and after the intervention using the DASS-21 questionnaire. The secondary outcomes were vital signs, including the heart rate, respiratory rate, and systolic and diastolic blood pressure, which were measured before and after the intervention.

Results: The individual characteristics of the aromatherapy and control groups were the same. There were no significant difference in the mean mental stress scores and vital signs of the aromatherapy and control groups on the second or third days after surgery.

Conclusion: Inhalation aromatherapy with lavender essential oil had no significant effects on mental stress and vital signs in patients following CABG, except the systolic blood pressure.

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Background

Coronary artery bypass surgery (CABG) is a common form of treatment for patients with coronary stenosis and over 73 million CABGs are performed annually in the United States alone.¹ Despite the technical success of open heart surgery, patients who undergo CABG usually suffer from major postoperative adverse events, including gastrointestinal bleeding, dysrhythmia, cardiologic shock, pain, delirium, severe stress, and vital sign changes.^{2–4}

CABG is reported to be associated with pre- and post-operative mental stress, which may impair coronary circulation, and thus there is an increased risk of angina pectoris and myocardial infarction.⁵ Many factors may increase mental stress in patients admitted to intensive care units (ICUs), including pain, sleep disorders, and being away from home and work.⁶ Stress can cause tachypnea, increased blood pressure, hypothermia, arterial vasoconstriction, and decreased tissue perfusion via stimulation of the sympathetic response.⁷ Mental stress and changes in vital signs may increase postoperative pain and analgesic usage indirectly, as well as decreasing resistance to infection, prolonging postoperative wound healing,⁸ and increasing the duration of hospitalization.⁹ Sedative medications are used frequently to decrease mental stress in patients following CABG, which is usually associated with adverse effects such as sedation and respiratory depression.¹⁰

Nonpharmacological approaches, which are classified as supplementary therapies, are safer than pharmacological approaches and they have less adverse effects.¹¹ In general, aromatherapy is used via massage, inhalation, and baths with herbal and mineral substances. The use of aromatherapy has increased substantially in recent years compared with other medical approaches.^{11,12} Aromatherapy is a technique where essential oils are used for inhalation,¹³ which can decrease pain, mental stress, and depression, and improve the vital signs.^{14–16}

Lavender essential oil is an essential oil that is used widely in aromatherapy, where its properties include sedative, antidepressant, antispasmodic, antibacterial, and local anesthetic effects. It can also be used to relieve migraines and insomnia.^{17,18} Studies of the benefits of the aroma of lavender have shown that linalool and linalyl acetate from this plant can stimulate the parasympathetic system. In addition, linalyl acetate has narcotic effects and linalool

acts as a sedative.^{11,19} This herb improves the heart function and it is a circulatory stimulant with beneficial effects on coronary blood flow.⁵ Studies have shown that the inhalation of lavender in aromatherapy is effective for reducing stress, depression, anxiety, and pain, as well as improving the vital signs in women who experienced Caesarean sections and volunteers who underwent needle insertions.^{14,15,20,21}

CABG is a common approach for coronary stenosis treatment but it is usually associated with mental stress and impaired vital signs, thereby demonstrating the importance of stress reduction strategies and stable vital signs in patients. Intensive care nurses have important roles in the assessment of stress and changes in the vital signs, as well as the implementation of appropriate measures and the evaluation of therapeutic effects. Thus, this study aimed to investigate the effects of inhalation aromatherapy using lavender oil in reducing mental stress and improving the vital signs of patients after CABG.

Methods

Design

A single-blinded randomized controlled trial was conducted with 60 patients following CABG, where the group assignments occurred in parallel.

Participants

All patients participated voluntarily in the study and gave their written informed consent. This study was conducted at Ekbatan Therapeutic and Educational Center, Hamadan, Iran, during 2013. The overall study process was approved by the Research Ethics Committee of Hamadan University of Medical Sciences and the protocol was registered by the Iranian Registry of Clinical Trials (No. 201203299014N9).

Patients who had undergone CABG were included if they met the following criteria in terms of the absence of: (a) chronic respiratory disease; (b) addiction to alcohol or narcotic substances; (c) history of head trauma or convulsion; (d) impaired sense of smell; or (f) using anti-anxiety drugs. Patients were excluded if they had: (a) eczema or allergies to plants; (b) impaired consciousness; (c) intubation for more than 24 h; or (d) hemodynamic instability. The details

of the study were explained to the participants and their informed consent was obtained in writing the day before surgery.

Measures

The data collection tool included a questionnaire with two parts and a checklist of items. The first part of the questionnaire included the patient's individual characteristics, i.e., gender, body mass index (BMI), educational level, and marital status. Additional information was collected including a history of hospitalization or open heart surgery in the family, as well as the duration of the operation and admission into the ICU. The second part of the questionnaire comprised the DASS-21 standard questionnaire, which has a reliability alpha coefficient of 0.90, and it contained 21 questions: seven questions regarding depression, seven questions regarding anxiety, and seven questions regarding stress.²² This questionnaire used a Likert scale, which was scored from zero to three as follows: "0" = "never," "1" = "sometimes," "2" = "usually," and "3" = "always." Scores of 0–7 were considered normal whereas scores greater than 7 were categorized as mild (8–9), moderate (10–12), severe (13–16), and very severe (17) mental stress. The checklist of items was used to recode vital signs, i.e., the systolic and diastolic blood pressure, heart and respiratory rate, and temperature, which were measured using a monitoring machine manufactured by SA-IRAN Co.

Interventions

The patients in the aromatherapy group inhaled two drops of 2% lavender oil in alcohol (produced by Barij Esans Co.) from an absorbable sticky patch inside an oxygen mask for 20 min on the second and third days after surgery. The patients in the control group inhaled two drops of distilled water as a placebo via an oxygen mask for the same period as the aromatherapy group. On the second and third days after surgery, we measured the mental stress levels in the aromatherapy and control groups before and 60 min after aromatherapy using the DASS-21 questionnaire. The vital signs, i.e., the heart rate, respiratory rate, and systolic and diastolic blood pressure were measured before aromatherapy and at 5, 30, and 60 min after aromatherapy using the monitoring machine.

Outcomes

The primary outcome was mental stress, which was evaluated subjectively according to the patients' responses. Mental stress was measured before and after the intervention using the DASS-21 questionnaire.²³ The secondary outcome measures were the vital signs, which were measured using a monitoring machine.

Sample size

In 2011, Hadi et al.²⁴ conducted a clinical trial with 200 pregnant women in order to assess the effects of lavender

on postpartum pain, which showed that the mean scores for pain in the intervention and control groups were 3.67 (SD = 1.60) and 5.29 (SD = 2.22) respectively. Thus, we used a sample of 30 for each group, i.e., a total sample of 60, which we tested at 95% significance levels and 90% statistical power (Fig. 1).

Randomization

The eligible patients were allocated randomly to the aromatherapy and control groups using balanced block randomization with blocks of four. The aromatherapy and control groups were assigned randomly to letters A and B. Thus, for each block of four patients, two were allocated in a random order to each treatment. Six sheets of paper were used to cover all possible states: AABB, ABAB, ABBA, BBAA, BABA, and BAAB. The assignments were then selected using a table of random numbers.

Allocation

The participants ($n=70$) were assigned randomly to two groups: aromatherapy ($n=35$) and control ($n=35$) groups. Follow-up losses occurred due to the discharge of patients in the aromatherapy ($n=3$) and control ($n=4$) groups on the third day after surgery. The intervention was discontinued in some subjects in the aromatherapy group ($n=2$) due to the intolerance of aromatherapy and in the control group ($n=1$) due to a lack of cooperation. In total, 60 patients (each group = 30) were analyzed in both the aromatherapy and control groups.

Blinding

In order to avoid any inductive effects of the aromatherapy, we used a single-blinded design where the assessor observed the outcomes and the interviewers were unaware of the treatment that each patient had received. Thus, the treatments were given to the patients by one researcher and the effects of the treatments were evaluated independently by another researcher.

Statistical methods

All of the statistical analysis was performed at the 0.05 confidence level using Stata 11 (Stata Corp, College Station, TX, USA). The relationships between the dependent and independent variables were investigated using independent *t*-tests for continuous variables and chi-squared tests for categorical variables.

Results

In this study, we evaluated the mental stress levels and changes in the vital signs before and after the intervention in aromatherapy and control groups. The majority of the patients in the aromatherapy group ($n=19$) and the control group ($n=23$) were male. The mean age in the aromatherapy group was 65.13 ± 9.76 years and that in the control was 65.63 ± 10.80 years, and there was no significant difference

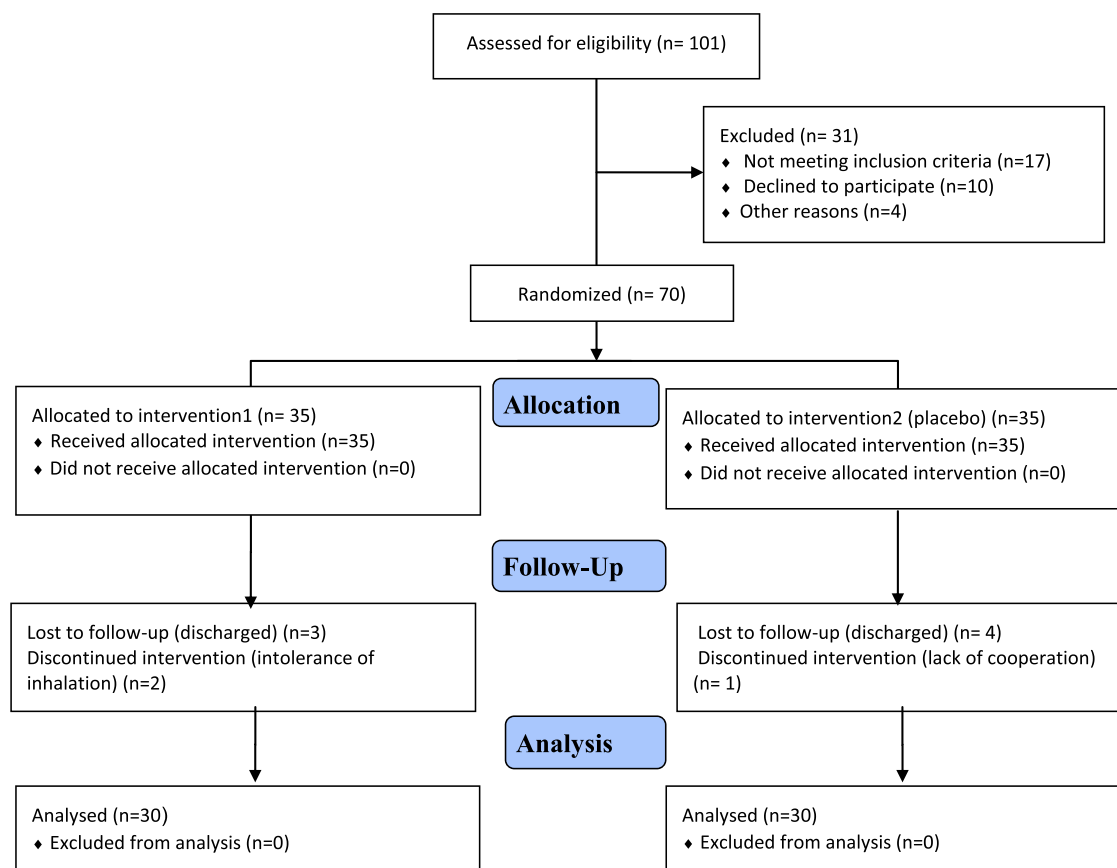


Figure 1 Trial profile.

in age between the groups ($P=0.852$). The mean BMI in the aromatherapy group was 26.50 ± 3.76 and that in the control group was 25.32 ± 3.43 , which did not differ significantly.

The majority of the patients in the aromatherapy group ($n=29$) were married and the remainder were single. Most of the patients in the control group ($n=27$) were married and the remainder were widows. The majority of the patients ($n=25$) were illiterate in both the aromatherapy and control groups. Most of the patients in the aromatherapy group ($n=26$) and the control group ($n=23$) had no history of hospitalization. In both groups, the patients had no family history of cardiac surgery.

The mean number of days of hospitalization in the ICU in the aromatherapy group was 3.27 ± 0.74 days and that in the control group was 3.3 ± 0.65 days, which did not differ significantly ($P=0.573$). Table 1 shows the characteristics of the study population, i.e., the age, gender, marital status, BMI, educational level, and any history of hospitalization and open heart surgery in the family. According to the results, there were no significant differences between the aromatherapy and control groups in terms of the individual characteristics that could have influenced the effects of the treatment.

Stress

Table 2 shows the mean mental stress scores based on the DASS-21 questionnaire. On the second day after surgery, the

Table 1 Individual characteristics of patients in the aromatherapy group (received lavender) and control group (received placebo).

Variables	Control group	Aromatherapy group
Gender		
Male	23	19
Female	7	11
Marital status		
Single	0	1
Married	27	29
Widow	3	0
Ethnicity		
Persian	11	11
Turkish	13	14
Kurdish	3	3
Lorish	3	2
Age (year)		
Mean (\pm SD)	65.63 (\pm 10.81)	65.13 (\pm 9.76)
Body mass index		
Mean (\pm SD)	25.32 (\pm 3.43)	26.50 (\pm 3.67)

mean stress score before intervention in the aromatherapy group was 15.13 and that in the control group was 15.27, but after the intervention the scores reduced to 7.60 and 8.1, respectively. On the third day after surgery, the mean

Table 2 Comparison of the mean differences in the mental stress of the aromatherapy group (received lavender) and control group (received placebo) according to the DASS-21 questionnaire.

Days after surgery	Control group		Aromatherapy group		Difference		P value*
	Mean	95% CI	Mean	95% CI	Mean	95% CI	
Second day							
Pre-intervention	15.27	15.05, 15.48	15.13	14.81, 15.45	0.13	0.51, 0.25	0.485
Post-intervention	8.10	7.13, 9.07	7.60	6.69, 8.51	0.50	-1.80, 0.80	0.444
Difference	7.17	6.18, 8.15	7.53	6.61, 8.46	0.37	0.36, 0.99	0.581
P-value ^a	0.001		0.001		0.586		
Third day							
Pre-intervention	15.43	15.11, 15.75	15.43	15.20, 15.67	0.00	-0.39, 0.39	1.000
Post-intervention	7.70	6.64, 8.76	7.03	6.20, 7.87	0.67	-1.98, 0.65	0.315
Difference	7.73	6.73, 8.74	8.40	7.56, 9.24	0.67	0.61, 1.95	0.301
P-value ^a	0.001		0.001		0.333		

CI, confidence interval.

* $P < 0.05$ was considered statistically significant.

stress scores before the intervention were 15.43 in the aromatherapy group and 15.53 in the control group, but after the intervention the scores were reduced to 7.03 and 7.70, respectively. Thus, the mean mental stress score decreased significantly after surgery in both groups but there were no significant differences between the aromatherapy and control groups before and after intervention on the second and third days after surgery.

Vital signs

Table 3 shows the vital signs of the patients in the aromatherapy and control groups before the intervention and at 5, 30, and 60 min after the intervention on the second and third days after surgery. On the second day, the heart rate was faster in the aromatherapy group and faster on the third day in the control group. The respiratory rate was faster in the aromatherapy group on both the second and third days. On the second day, the systolic blood pressure was higher in the control group and on the third day in the aromatherapy group, while the diastolic blood pressure was higher in the aromatherapy group on both the second and third days. However, there were no significant differences between the vital signs in the aromatherapy and control groups on the second and third days after surgery, except for the systolic blood pressure on the third day after 5 and 30 min, and the diastolic blood pressure on the third day after 5 min (Table 3).

Discussion

In this study, we found that inhalation aromatherapy had no significant effects on mental stress in patients who had undergone CABG. Indeed, the mean mental stress levels of the patients in both groups decreased after the treatments compared with those before the intervention. The strengths of our study include the use of separate assessors and data analysts, as well as the use of inhalation aromatherapy on two different days. A limitation of this study is that the relationship between smells and memories can be

influential. Smells can trigger memories, so negative results may be obtained if the smell of an essential oil applied to a patient is closely associated with negative memories. To improve this study, we could have tested the subjects on more days and applied the aromatherapy for longer (continuation after discharge in the home), as well as including more patients in the sample.

Open heart surgery is a stressful experience. Several studies have reported that patients suffer from mental stress after CABG.^{6,23} We found that the patients experienced severe mental stress before the intervention in both the aromatherapy and control groups. This may have occurred because pain and other causes of stress such as fear of surgery and anesthesia had not been resolved. Fear and anxiety about one's future health status may also persist after surgery, which could affect the mental health status. Rymazewska et al.²⁵ reported that patients who were CABG candidates experienced severe stress before surgery but their stress decreased considerably a few days after surgery, and it continued to increase gradually for three months subsequently, which agreed with our results.

We did not find any significant difference in the mean stress scores between genders. However, some studies have reported that the stress levels differ between males and females, which was not confirmed by our results. Furthermore, we found no relationship between educational level and mental stress in the patients, which agreed with the results reported by Dehdari et al.²⁶

Many studies have been conducted in order to decrease mental stress in patients using aromatherapy. In agreement with our results, Muzzarelli et al.²⁷ indicated that inhalation aromatherapy using lavender essence had no significant effect on mental stress and anxiety ($P = 0.630$). By contrast, Kim et al.¹⁴ assessed the effect of inhalation aromatherapy in decreasing mental stress in patients and they reported a significant effect ($P < 0.001$). In our study, the duration of lavender use continued for only 20 min, so the mean stress level might have differed significantly between the two groups if the duration of lavender use had been continued for longer or maintained at home.

Table 3 Comparison of the mean differences in the homodynamic measurements for the aromatherapy group (received lavender) and control group (received placebo).

Clinical signs and symptoms	Control group		Aromatherapy group		Difference ^a	
	Mean	95% CI	Mean	95% CI	Mean	95% CI
Temperature (°C) on 2nd day						
After 5 min	36.75	36.48, 37.01	36.79	36.60, 37.02	0.05	-0.29, 0.39
After 30 min	36.74	36.60, 37.00	36.79	36.57, 37.00	0.05	-0.28, 0.38
After 60 min	36.91	36.73, 37.10	36.92	36.76, 37.07	0.01	-0.24, 0.24
Temperature (°C) on 3rd day						
After 5 min	36.75	36.59, 36.90	36.70	36.52, 36.87	0.05	-0.27, 0.18
After 30 min	36.77	36.62, 36.85	36.71	36.54, 36.88	0.06	-0.29, 0.16
After 60 min	36.94	36.79, 37.10	36.74	36.51, 36.97	0.20	-0.48, 0.08
Respiratory rate (breath/min) on 2nd day						
After 5 min	20.93	18.66, 23.21	22.53	20.35, 24.72	1.60	-1.48, 4.69
After 30 min	20.90	18.82, 22.98	23.23	20.62, 25.84	2.33	-0.93, 5.60
After 60 min	22.23	19.97, 24.49	21.43	19.00, 23.87	0.80	-4.05, 2.45
Respiratory rate (breath/min) on 3rd day						
After 5 min	24.80	22.37, 27.23	24.80	22.22, 27.39	0.00	-3.47, 3.47
After 30 min	24.10	21.94, 26.26	24.20	21.56, 26.84	0.10	-3.24, 3.44
After 60 min	24.50	23.48, 26.71	25.73	23.20, 28.26	1.23	-2.05, 4.52
Heart rate (beat/min) on 2nd day						
After 5 min	79.27	75.88, 82.66	77.93	75.03, 80.84	1.33	-5.70, 3.04
After 30 min	80.80	76.48, 85.12	78.33	75.41, 81.26	2.47	-7.57, 2.64
After 60 min	81.30	77.00, 85.60	77.67	74.63, 80.71	3.63	-8.79, 1.52
Heart rate (beat/min) on 3rd day						
After 5 min	81.10	73.37, 88.83	81.30	76.56, 86.04	0.20	-8.68, 9.08
After 30 min	82.33	75.11, 89.55	85.17	80.76, 89.58	2.83	-5.45, 11.11
After 60 min	83.00	76.25, 89.81	82.20	78.29, 86.11	0.80	-8.49, 6.89
Systolic blood pressure (mmHg) on 2nd day						
After 5 min	118.80	109.19, 128.41	125.57	119.04, 132.10	6.77	-4.60, 18.13
After 30 min	119.20	109.66, 129.15	126.10	118.80, 133.40	6.90	-5.18, 18.98
After 60 min	123.27	116.81, 129.72	125.60	118.15, 133.05	2.33	-7.31, 11.98
Systolic blood pressure (mmHg) on 3rd day						
After 5 min	114.00	106.92, 121.08	127.00	118.40, 135.60	13.00	2.10, 23.90
After 30 min	116.13	107.73, 124.54	130.63	121.29, 139.37	14.50	2.20, 26.80
After 60 min	117.53	110.68, 124.39	126.83	116.89, 136.77	9.30	-2.52, 21.12
Diastolic blood pressure (mmHg) on 2nd day						
After 5 min	75.00	70.96, 79.04	76.27	71.45, 81.08	1.27	-4.89, 7.42
After 30 min	76.83	72.71, 80.95	77.40	72.92, 81.88	0.57	-5.39, 6.53
After 60 min	74.60	70.31, 78.89	76.07	71.80, 80.33	1.47	-4.45, 7.39
Diastolic blood pressure (mmHg) on 3rd day						
After 5 min	69.63	65.86, 73.41	76.73	71.90, 81.56	7.10	1.10, 13.10
After 30 min	72.63	67.50, 77.77	79.87	74.29, 85.44	7.23	-0.18, 14.65
After 60 min	73.07	67.91, 78.22	36.43	71.38, 81.48	3.37	-3.67, 10.43

^a The 95% confidence intervals (CI) including zero are not statistically significant.

In this study, we found that lavender essence had no significant effects on the all vital signs, except for the systolic blood pressure. Hwang et al.²⁸ also investigated the effect of inhalation aromatherapy using lavender oil essence on blood pressure and they showed that lavender could significantly reduce the blood pressure ($P < 0.05$), which agreed with our results. By contrast, Shiina et al.⁵ reported that lavender essence had no effect on blood pressure. The

discrepancy between the results of these studies may be due to differences in the lavender dose and duration. Rho et al.²⁹ reported that aromatherapy had no significant effect on the respiratory rate, which agreed with our results.

Inhalation aromatherapy could be use by CABG patients before and after surgery, including follow-up in the home and during rehabilitation after surgery. Policy makers and clinicians might consider that lavender inhalation

aromatherapy is a complementary method with low costs but no risk, which is simple to apply, and thus it could be used in the home by families or patients. Further research should assess lavender inhalation aromatherapy using different doses, time periods, for different diseases, and with larger samples.

Studies should also test the continuous use of lavender aromatherapy for several days in hospitals and in the home.

Conclusion

We found that lavender inhalation aromatherapy had no significant effect on mental stress and the vital signs in CABG patients, although it had a significant effect on systolic blood pressure. However, these changes in the systolic blood pressure may be due to a type I error (multiple hypothesis testing).

Other information

Based on the results of this study, as well as the interest and willingness of nurses to use complementary methods for reducing the side effects of medications, this method could be applied by nurses, physicians, and other members of treatment teams.

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Conflict of interest statement

The authors declare that they have no conflicts of interest.

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