

Effect of Lavender Aromatherapy on Sleep Quality and Physiological Indicators in Patients after CABG Surgery: A Clinical Trial Study

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ABSTRACT

Background: Sleep disorders occur in the first days after heart surgery. One of the major causes of sleep disorders after coronary artery bypass graft (CABG) is subsequent changes in physiological indicators, such as systolic blood pressure (BP), respiratory rate (RR), saturation of oxygen (O₂), and heart rate (RR). This study is aimed to determine the effect of lavender aromatherapy on patients' sleep quality and physiological indicators after CABG.

Materials and methods: This study was a randomized clinical trial. Patients after CABG surgery were randomly allocated into the lavender and distilled water groups. Patients in the intervention group inhaled lavender while those in the control group inhaled distilled water for 10 hours. Sleep quality and physiological postoperative data were collected for 3 days. Data were analyzed using repeated measurement test, sample t-test, and Chi-square test.

Results: Repeated measurement test showed no significant difference between the lavender and distilled water groups in terms of systolic BP, RR, O₂ saturation, HR, and body temperature after matching the effect of time and its interactive effect with the intervention ($p > 0.05$). This test revealed a significant difference between the lavender and distilled water groups in terms of sleep quality ($p < 0.001$), such that the sleep quality was higher in the lavender group.

Conclusion: Lavender aromatherapy can increase patients' sleep quality after CABG surgery. However, it cannot completely treat sleep disorders in such patients. Furthermore, aromatherapy with lavender does not affect the physiological parameters, such as HR, BP, RR, and O₂ saturation.

Keywords: Aromatherapy, Physiological indicators, Sleep quality.

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INTRODUCTION

According to the World Health Organization (WHO) report in 2019, cardiovascular disorders are the most common cause of mortality in the world, and about 17.9 million people die each year of such diseases worldwide.¹ According to the WHO report, 43% of Iranians die of cardiovascular diseases.² A large proportion of cardiovascular diseases are related to coronary artery diseases (CAD). People with CAD are initially treated with medication.³ However, some of these patients who do not respond to medical treatment undergo coronary artery bypass grafting (CABG).⁴ In Iran, CABG comprises about 60% of open-heart surgeries.⁵ Like other surgeries, CABG causes problems for patients including disturbances in sleep and physiological parameters.^{6,7}

Sleep disorders occur in 60 to 80% of patients in the first days after heart surgery⁸ and can increase mortality, morbidity, and use of resources.⁹ One of the major causes of sleep disorders after CABG is anxiety and subsequent changes in physiological indicators, such as systolic blood pressure (BP), saturation of oxygen (O₂), and respiratory rate (RR) and heart rate (HR) per minute.⁷ Accordingly, it is important to enhance patients' sleep quality and improve physiological indicators after CABG surgery.

Interventions used to promote sleep quality and physiological indicators in patients include nonpharmacological and pharmacological methods. Currently, pharmacological methods are mostly used to treat sleep disorders and improve physiological indicators.^{10,11} However, sleep drugs can lead to complications, such as cognitive impairment, suppression of the respiratory

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system, and the risk of tolerance and dependence.¹² For example, opioids, benzodiazepines, and *barbiturates* disturb normal sleep rhythm and reduce stage 3 of sleep and rapid eye movement activity.¹³ Pharmacological treatments are more effective than nonpharmacological treatments in inducing sleep in patients. Meanwhile, nonpharmacological treatments have fewer side

effects.¹⁴ Accordingly, nonpharmacological treatments for improving sleep have become more important. Aromatherapy with French lavender is one of the approaches that may increase sleep quality and improve physiological parameters after CABG surgery.

Linalool acetate and linalool are the active lavender ingredient and linalool actions as a gamma-aminobutyric acid receptors sedative in the central nervous system (CNS).¹⁵ Inhaling lavender scent calms the patient and improves physiological indicators by reducing the adrenal gland cortisol secretion, reducing the activity of the sympathetic system, and increasing the activity of the parasympathetic system. Lavender inhibits acetylcholine release, and linalool acetate can relax the smooth muscles of the arteries. Furthermore, lavender calms the nervous system due to the presence of a substance called ester.¹⁶

Some studies have investigated the lavender effect on anxiety, pain, sleep, and physiological indicators in patients after cardiac surgery.¹⁷⁻²¹ However, the results are contradictory. For example, Bikmoradi et al. reported that lavender aromatherapy did not affect patients' stress and vital signs after CABG.²¹ Rajai showed that aromatherapy with lavender could reduce anxiety and improve physiological indicators in patients after CABG surgery.²⁰ Therefore, because of these contradictions regarding the use of lavender to improve physiological and anxiety indicators in studies, and that the authors did not find a study that had simultaneously investigated the effect of lavender on sleep quality and physiological indicators in patients after CABG surgery, this study is aimed to determine the effect of lavender aromatherapy on patients' sleep quality and physiological indicators after CABG surgery.

MATERIALS AND METHODS

Study Design and Participants

This study was a not-blinded, randomized clinical trial (ID: IRCT2017060811399N6) conducted between July 23, 2017, to March 20, 2018. The study population comprised 50 patients after CABG surgery in Kowsar Hospital Open-Heart ICU, Semnan, Iran. The study sample consisted of those patients who met the following inclusion criteria: patients' willingness to contribute in this study, nonemergency open-heart surgery, the age range of 30–75 years, stable hemodynamic conditions, no opium drug use in his/her history, no confirmed mental illness, no history of allergy to lavender aromas or any seasonal allergies, no known olfactory disorders, no known respiratory disorders, such as asthma or chronic obstructive pulmonary disease (COPD), having complete alertness, and having full hearing and speaking ability.

The exclusion criteria comprised taking sedating medications in addition to routine, life-threatening dysrhythmias, any emergency situations requiring immediate intervention, unwillingness to contribute in this study, loss of consciousness, sensitivity to lavender odor, or any allergic reaction during the study.

Sample Size Estimated

Initially, a pilot study was performed to estimate the sample size. Twenty patients were divided into two groups: lavender and distilled water. The lavender group had a sleep quality score mean and standard deviation of 25.30 ± 5.55 , and the distilled water or control group had a sleep quality score mean and standard deviation of 30.10 ± 5.42 . The sample size was estimated using the G*power software with a confidence interval of 95%, a test power of 90%, and an effect size of 0.875. The maximum sample size obtained was 24 patients per group.

Measures

Data collection tools were demographic and physiological parameter information and St Mary's Hospital Sleep Questionnaire (SMHSQ). The demographic and physiological parameter information of patients were complete after obtaining informed consent. This information including age, gender, underlying diseases, such as COPD, diabetes mellitus, hypertension, and hyperlipoproteinemia (HLP), level of education, history of smoking, job, weight, height, body mass index (BMI), ejection fraction, systolic BP, body temperature, O₂ saturation, and HR and RR per minute.

The SMHSQ score was used to assess patients' previous night's sleep quality. In this present study, the 11-question format of this questionnaire was used. The minimum score of this questionnaire was 11, which was interpreted as lack of sleep quality disorder and the maximum score was 44, demonstrating the highest amount of sleep quality disorder. This questionnaire's answers to never score 1, very little score 2, some extent score 3, and a lot score 4. Scores 11–21 showed mild sleep quality disorder, 22–32 moderate, and 33–44 severe.²² This questionnaire has validity for patients' sleep studies at the hospital and has been used in some studies.^{22,23} Ghorbani et al. confirmed the SMHSQ's reliability by computing a Cronbach's alpha of 0.91.⁹ A Cronbach's alpha of 0.87 also confirmed the reliability of the SMHSQ tool in the present study.

Randomization

After CABG surgery, eligible people were randomly divided into lavender and distilled water groups. Computerized block randomization was used to randomize.

Intervention

Eligible patients entered the study after they were fully conscious and extubated. On the first night after surgery, all patients in both groups slept with a sedative (benzodiazepine) due to severe pain. Therefore, the intervention started on the second night postop and it was not possible to record patients' sleep status and vital signs before the interventions because these variables were affected by the injected painkiller and were not valid. For three consecutive nights from the second night postop, in the intervention group two drops of lavender essence and in the control group two drops of distilled water were applied to a cotton pellet and held before the patients' nose. They were asked to take 10 effective breaths. The cotton pellet was then attached to the patients' collar where it remained until 8 a.m. the next day. These interventions were performed in both the lavender and the distilled water groups on the third and fourth nights after surgery. Patients' sleep quality was measured using SMHSQ and their vital signs were recorded in both groups at 8 a.m. the day after the interventions.

Statistical Methods

Data were analyzed using descriptive statistics, including frequency, mean and standard deviation. Chi-square test was applied to compare patients' gender, underlying diseases, marital status, history of smoking, level of education, and job. Independent *t*-test was applied to compare patients' mean weight, age, height, BMI, and ejection fraction before the interventions. Independent sample *t*-test was applied to compare patients' systolic BP, body temperature, O₂ saturation, HR, and RR between the two groups before and after the interventions.

Independent sample *t*-test and Chi-square test were performed to compare patients' demographic data before the interventions.

Independent sample *t*-test and repeated measurement test were performed to compare patients' mean sleep quality score and physiological parameters over 3 days of continuous measurement. Data were analyzed at a significance level of 0.05.

Ethical Considerations

This study protocol was approved by the Ethics Committee of Semnan University of Medical Sciences (approval code: IR.SEMUMS.REC.1396.14) and registered at the Iranian Registry of Clinical Trials (registration code: IRCT2017060811399N6). All patients participating in the study provided informed consent the day after CABG surgery, and coordinated with Kowsar Hospital administrators and Open-Heart ICU nurses before sampling. The study goals and method were also clarified to the patients and informed consent was obtained.

Findings

In a total of 62 patients after CABG surgery, 57 patients were eligible to participate in this study. Seven people were excluded from this study during the sampling process because of their unwillingness to contribute to this study (one patient), loss of consciousness (one patient), taking sedating medications in addition to routine (three patients), and life-threatening dysrhythmias (two patients), and lastly, the data of 50 people were analyzed (Flowchart 1).

The participants were 15 females (30%) and 35 males (70%). Their mean and standard deviation age was 62.18 ± 9.52 years. Thirty-six patients (72%) had primary education. Six patients (12%) were government employees, three (6%) were workers, eight (16%) were retired, and 22 (44%) were employed in other occupations. Twenty-six patients (52%) had a history of hypertension, 13 (26%) had diabetes, four (8%) had COPD, and 20 (40%) had hyperlipidemia. Fourteen patients (28%) were active smokers. Before the intervention, patients in both groups were matched in terms of gender, age, educational level, smoking history, occupation, type of underlying disease, height, weight, BMI, and ejection fraction

($p > 0.05$) (Table 1). There was no significant difference between sleep quality scores and physiological variables before the interventions, and both groups were matched in terms of these variables ($p > 0.05$) (Table 1).

The mean and standard deviation of sleep quality scores of patients in the lavender group after the first intervention was 30.04 ± 4.82 , the second intervention was 24.96 ± 5.03 , and the third intervention was 25.08 ± 4.98 . The mean and standard deviation of patients' sleep quality scores in the control group after the first intervention was 30.36 ± 5.77 , the second intervention was 30.68 ± 5.88 , and the third intervention was 28.44 ± 6.62 . Independent *t*-test revealed a statistically significant difference in the sleep quality scores between the two groups on the second and third days after the intervention, such that sleep quality in the lavender group enhanced compared to the control group ($p < 0.05$). However, there was no statistically significant difference in physiological indicators between the two groups on the second and third days after the intervention ($p > 0.05$) (Table 2).

Repeated measures showed no significant difference between the lavender group and control group in terms of systolic BP, O_2 saturation, HR, body temperature, and RR after matching the effect of time and its interactive effect with the intervention ($p > 0.05$). However, this test revealed a significant difference between the intervention and control groups in terms of sleep quality ($p < 0.001$), such that the sleep quality was higher in the lavender group (Table 3).

DISCUSSION

In this study, patients in both groups slept with the help of strong sedatives on the first night after CABG according to the ward routines; therefore, the interventions began the second night after CABG.

The mean sleep quality scores were moderate after the first intervention in both the lavender and distilled water groups. The mean score dropped to 5.08 and 4.96, respectively, after the

Flowchart 1: Flow of patients through the trial

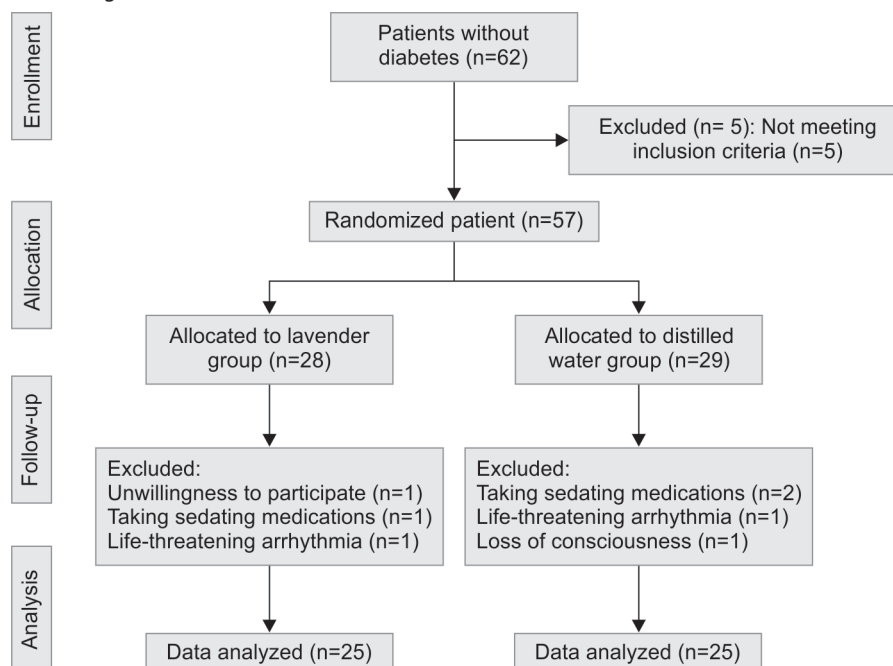


Table 1: Demographic variables and hospitalization data

Variables	Frequency in groups			"p" value
	Lavender	Control	Total	
Age (year)	62.40 ± 9.62	61.96 ± 9.62	62.18 ± 9.52	0.802b
Gender, n (%)				
Male	16 (45.7)	19 (54.3)	35 (100)	0.538c
Female	9 (60.0)	6 (40.0)	15 (100)	
Educational level, n (%)				
Primary school	20 (55.6)	16 (44.4)	36 (100)	0.398c
Diploma	4 (40)	6 (60)	10 (100)	
High school	1 (25)	3 (75)	4 (100)	
Type of job, n (%)				
Government employees	2 (33.3)	4 (66.7)	6 (100)	0.405c
Proletarian	1 (33.3)	2 (66.7)	3 (100)	
Unemployed	6 (54.5)	5 (45.5)	11 (100)	
Retired	6 (75.0)	2 (25.0)	8 (100)	
Other jobs	10 (45.5)	12 (54.5)	22 (100)	
Underlying diseases, n (yes, no)				
Hypertension (yes, no)	14, 11	15, 10	29, 21	0.198c
Diabetes mellitus (yes, no)	6, 19	7, 18	13, 37	0.500c
COPD (yes, no)	2, 23	2, 23	4, 46	0.695c
HLP (yes, no)	8, 17	12, 13	20, 30	0.193c
Habit of smoking, n (%)				
Yes	6 (42.9)	8 (57.1)	14 (100)	0.377c
No	19 (52.8)	17 (47.2)	36 (100)	
Weight (kg)	72.96 ± 11.27	74.56 ± 9.06	73.76 ± 10.15	0.583c
Height (cm)	166.32 ± 6.38	169.04 ± 7.60	167.68 ± 7.08	0.177c
BMI	26.32 ± 3.87	26.12 ± 3.21	26.24 ± 3.52	0.843c
Ejection fraction	47.80 ± 8.04	47.60 ± 6.63	47.70 ± 7.29	0.924c

Data are presented as n (%), yes/no, or mean ± SD. SD, standard deviation; b, independent sample t-test; c, Chi-square test

second and third interventions in the lavender group. However, the mean score increased by 0.32 after the second intervention and decreased by 1.92 after the third intervention in the control group. Statistical tests also showed that the mean sleep quality scores were not significantly different between the two groups after the first intervention, but the difference became significant after the second and third interventions. Cheraghbeigi et al. reported that lavender can increase sleep quality in people with heart diseases.²⁴ Moeini et al. reported that inhaling lavender can increase sleep quality in patients with ischemic heart disease. In their study, the mean sleep quality score decreased by 6.42 after inhaling lavender reaching from 20.12 to 13.97.²²

In a study, Babamohamadi et al. showed that aromatherapy could increase patients' sleep quality after heart surgery.²⁵ Ghorbani et al. also showed that complementary medicine could increase patients' sleep quality after CABG surgery.⁹ Lavender appears to increase patients' sleep quality after CABG by reducing stress and anxiety.²⁶ However, this hypothesis needs further studies. The findings of our study and other studies on the effect of complementary medicine and aromatherapy on patients' sleep quality after heart surgery showed that aromatherapy with lavender and other complementary therapies significantly increased patients' sleep quality, but they could not completely

alleviate patients' sleep problems. Therefore, it is recommended that further studies be conducted using other complementary therapies. The combined use of complementary medicine and conventional medications may further treat the problem of patients' sleep disorders after heart surgery.

The present study showed that lavender inhalation did not have a significant effect on patients' physiological parameters after CABG surgery. To confirm this finding, Bikmoradi et al. showed that lavender aromatherapy did not affect patients' vital signs after CABG.²¹ However, Abdelhakim et al. showed that lavender could reduce HR in patients after heart surgery, but it did not affect their BP.²⁷ Ebrahimi Hossein Abadi et al. reported that lavender aromatherapy could only affect patients' BP after CABG and had no effect on other physiological parameters.²⁸ In a study, Rajai et al. showed that lavender aromatherapy could improve physiological indicators in patients after CABG.²⁰ A comparison of the results of our study with other similar studies reveals the contradictory effect of lavender aromatherapy on physiological parameters after CABG. Different administration methods, administration times, research settings, and demographic characteristics of the participants in different studies appear to cause these contradictions. Therefore, more studies are needed to show the exact lavender effect on physiological parameters after CABG surgery.

Table 2: Comparison of mean patients' physiological parameters and SMHSQ score before and after interventions in the two groups studied

Physiological parameters	Times	Lavender M ± SD	Control M ± SD	"p" value
Systolic blood pressure	1 day after intervention	115.48 ± 19.08	110.72 ± 19.54	0.388
	2 days after intervention	111.52 ± 20.95	109.36 ± 21.75	0.722
	3 days after intervention	114.96 ± 20.39	121.76 ± 19.40	0.233
Heart rate	1 day after intervention	93.88 ± 12.72	94.84 ± 16.72	0.820
	2 days after intervention	90.48 ± 12.71	92.80 ± 12.04	0.511
	3 days after intervention	91.56 ± 11.55	90.52 ± 13.82	0.774
Respiratory rate	1 day after intervention	13.28 ± 2.45	14.08 ± 2.15	0.227
	2 days after intervention	13.24 ± 2.55	13.20 ± 2.81	0.958
	3 days after intervention	12.72 ± 3.23	12.48 ± 3.21	0.794
Temperature	1 day after intervention	36.79 ± 0.37	36.92 ± 0.42	0.283
	2 days after intervention	36.99 ± 0.17	37.06 ± 0.41	0.451
	3 days after intervention	36.90 ± 0.28	36.92 ± 0.31	0.853
O ₂ saturation	1 day after intervention	97.32 ± 1.60	97.64 ± 1.80	0.510
	2 days after intervention	92.96 ± 2.35	94.44 ± 2.88	0.053
	3 days after intervention	93.00 ± 2.94	92.96 ± 3.48	0.965
SMHSQ score	1 day after intervention	30.04 ± 4.82	30.36 ± 5.77	0.833
	2 days after intervention	24.96 ± 5.03	30.68 ± 5.88	0.001*
	3 days after intervention	25.08 ± 4.98	28.44 ± 6.62	0.048*

An independent sample t-test

Table 3: Results of analysis of variance with observation repetition approach

Factors	Sum of squares	df	Mean square	F	Sig.
Systolic blood pressure	919.480	2	459.740	1.03	0.361
Heart rate	71.413	2	35.707	0.254	0.776
Respiratory rate	0.073	2	0.036	0.345	0.709
Temperature	7.613	2	3.807	0.473	0.624
O ₂ saturation	15.773	2	7.887	1.244	0.293
SMHSQ score	183.213	2	91.607	4.879	0.010*

*There was a significant difference between the intervention groups and the sleep quality was higher in the lavender group.

CONCLUSION

Aromatherapy with lavender can improve sleep quality in patients undergoing CABG. However, it cannot completely treat sleep

disorders in such patients. Furthermore, lavender aromatherapy does not affect physiological parameters, such as HR, BP, RR, and O₂ saturation. Therefore, it is suggested that lavender aromatherapy be used as a complementary measure to conventional medications to increase sleep quality in patients after CABG surgery.

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Author Contributions

AE, MT, and HD conceived and designed the study. AE devised and developed the project and wrote the first draft of the manuscript. HD developed data collection. AE and MT were involved in data management and analysis and edited the manuscript. AE supervised the conduct of the study and data collection. All authors contributed to the review and revision of the manuscript and all took responsibility for the final version. All authors read and approved the manuscript.

Ethical Considerations

This study protocol was approved by the Ethics Committee of Semnan University of Medical Sciences (approval code: IR.SEMUMS.REC.1396.14) and registered at the Iranian Registry of Clinical Trials (registration code: IRCT2017060811399N6).

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