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Effects of Aromatherapy Using Lavender Oil on Hemodynamic Indices After Coronary Artery Bypass Graft Surgery

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ABSTRACT

Introduction: Coronary Artery Bypass Graft (CABG) surgery is one of the main treatment methods for coronary artery disease. The change in hemodynamic indices after CABG surgery is a common but serious complication.

Objective: This study aimed to determine the effect of aromatherapy using lavender essential oil on the hemodynamic indices of patients after undergoing CABG surgery.

Materials and Methods: This randomized, double-blind, placebo-controlled clinical trial included 98 patients who were assigned into an experimental or a placebo group 3 days after undergoing CABG surgery. The experimental group inhaled five drops of lavender essential oil, whereas the placebo group inhaled five drops of distilled water for 30 min. Before and after the intervention, hemodynamic indices (systolic blood pressure, diastolic blood pressure, pulse rate, and respiratory rate) of patients were measured and recorded. The intervention in both groups was performed every 24 h for three consecutive days. The data were analyzed using the chi-square test, independent t-test, Mann–Whitney U test, repeated measures ANOVA, and regression analysis.

Results: The results revealed significant differences between the two groups in terms of the mean systolic blood pressure after the second day of intervention and the mean diastolic blood pressure after the first day of intervention (P=0.046 and 0.029, respectively), with the blood pressure significantly lower in the treatment group than in the placebo group.

Conclusion: Among the hemodynamic indices tested, only the blood pressure of the patients was reduced by aromatherapy with lavender essential oil after CABG surgery; therefore, it can be used as a simple, complementary, and low-cost therapeutic intervention after CABG surgery to stabilize a patient's blood pressure.

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Introduction

Coronary Artery Bypass Graft (CABG) surgery is one of the main treatment methods for coronary artery disease [1, 2] and the most common type of heart surgery [3, 4]. However, surgery is a stressor that can cause pathological stress involving psychological (anxiety and fear) and physiological (neuroendocrine responses) reactions. The physiological changes due to stress increase with the increase in the extent of the surgery [4]. CABG surgery is commonly associated with stress and disruption of vital signs [1].

Anxiety [2, 5, 6] and pain [7-9] are common problems experienced by patients undergoing cardiac surgery, both of which stimulate the sympathetic nervous system, causing an increase in the blood pressure and heart rate as well as shallow and rapid respiration. Both anxiety and pain increase the oxygen demand of the body and especially of the heart muscles, consequently increasing the load on the heart [7, 10].

In addition to being expensive, drugs used to treat these problems have many adverse physical and psychological effects [11], such as sleepiness, suppression of the immune system [12], imbalance, mild amnesia, and extreme dose-dependent sedation [13]. Complementary and alternative therapies are less harmful compared with the pharmacological methods [14] and can be used alone or in combination with other methods [15]. Aromatherapy has recently become a common complementary treatment used in many countries [16, 17].

Lavender essential oil is the most popular and widely used essential oil in aromatherapy [18]. It is prepared from the flowering parts of Lavandula spica L. [19, 20], and to date, there has been no report about its toxicity [18]. Studies on the effects of aromatherapy with lavender essential oil on the hemodynamic indices of patients have reported controversial results. In the study by Tahmasebi et al. [21], the lavender scent significantly reduced the systolic blood pressure, pulse rate, and respiratory rate of patients undergoing coronary angiography but had no significant effect on the diastolic blood pressure. Chien et al. [22] reported a significant reduction in the mean heart rate of midlife women with insomnia on the 4th and 12th week of lavender aromatherapy.

Few studies have evaluated on the effects of lavender aromatherapy on the hemodynamic indices of patients after CABG surgery. Given the importance of the stability of hemodynamic indices in these patients and considering that complementary therapeutic interventions can be performed by nurses [23], the current study aimed to determine the effects of aromatherapy with lavender essential oil on the hemodynamic indices of patients after CABG surgery.

Materials and Methods

The present study was a randomized, double-blind, placebo-controlled clinical trial that was performed using permuted block randomization of patients who 3 days after underwent CABG surgery and were admitted to one of the teaching medical centers of Rasht City. The inclusion criteria were as follows: age of ≥18 years; ability to comprehend; no history of medications affecting the nervous system according to the patient's records; no olfactory disorder; complete awareness; no history of allergies, contact dermatitis, or allergy to plants, especially lavender or cosmetic fragrances; no acute illness; no history of aromatherapy (according to the patient); no history of diseases of as the lung or liver, chronic headaches, migraines, or active mental disorders; no history of thyroid disease or heart surgery; willingness to cooperate; no addiction to drugs, smoking, or alcohol (according to the patient's records); and a systolic blood pressure of ≥95 mmHg at the start of the study [24].

The exclusion criteria were as follows: sudden onset of any severe changes in vital signs, signs of possible respiratory allergies, or a systolic blood pressure of <95 mmHg on each day of the study intervention [24]. Thus, of the 280 patients who underwent CABG surgery during the sampling period, 28 who used drugs for nervous system disorders, 12 for pulmonary diseases, 5 for active psychological illness, 21 for thyroid disease, 19 for unwillingness to participate in the study, 33 for drug addiction, 12 for smoking, 2 for sensitivity to plants, 5 for allergy to cosmetic fragrances, 6 for >72-h hospitalization in the ICU, 12 for >8-h intubation duration, and 10 for lack of comprehension ability were not included in the study. In addition, 14 patients due to respiratory symptoms, one patient due to transfer to the cardiac care unit, one due to early discharge (before the end of 3 days of intervention), and one due to systolic blood pressure <95 mm Hg were excluded from the study.

In accordance with the study by Tahmasebi et al. [21], a sample size of 49 patients in each of the two groups (experimental and placebo)was determined for the two-tailed test, with 95% confidence level, 95% power, and a significance level of 0.05. Data were collected using a researcher-made questionnaire containing three

sections: The first section included demographic data (age, gender, education level, marital status, place of residence, and employment status); the second section contained information about medical history (history of previous hospitalization for non-surgical reasons and history of non-cardiac surgery); and the third section included information about vital signs (systolic blood pressure, diastolic blood pressure, pulse rate, and respiratory rate). An OMAX chronometer (Switzerland) was used for measuring pulse and respiratory rates, and a barometer model ALPK2 (Japan) was used for measuring the systolic and diastolic blood pressure of all participants.

The content validity method was used to determine the validity of the demographic questionnaire and of the questions related to medical history. For this purpose, after reading the related books and published papers, the questionnaire was adjusted and distributed among 13 faculty members. The final version of the questionnaire was prepared after reviewing their comments.

Patients were randomly assigned to the experimental and placebo groups after being discharged from the intensive care unit and admitting in the cardiac surgery ward. Signed written consent forms were obtained from the patients, and the patients were asked to complete the questionnaire. All patients underwent a skin test to ensure that they were not allergic to lavender. In this test, one drop of lavender oil (Barij Essence Pharmaceutical Co., Kashan, Iran) was dabbed on the inner side of the patients' wrist, and their wrists were dressed with compression bandages to prevent inhalation of the aroma; 2 min later [25], the location of oil on the wrists was observed for the presence of allergic symptoms (redness, hives, itching, etc.), in the absence of which, the patients were entered into the study. No patient showed allergic reactions to lavender. The study intervention was then performed as follows.

On the first day of the study, five drops of 20% concentrated lavender essential oil for the experimental group, and five drops of distilled water for the placebo group were poured onto sterile gauze. The gauze was then fixed at the middle of a 70-cm band, which was then tied around the patients' neck like a necklace for three successive days. On the second and third days, five more drops of the essential oil and distilled water were added to the sterile gauze in the corresponding groups. For all participants, this intervention was performed between 12:00 and 13:00 on all three successive days of the study.

To observe the double-blind nature of the study, data on hemodynamic indices were collected by a fellow examiner who was blinded to the group allocation. He measured hemodynamic indices before each intervention and half an hour after the intervention. The pulse and respiratory rates were measured and recorded for a full minute. Blood pressure was measured from the right arm of all subjects in the supine position.

The obtained data were analyzed by SPSS v.16 using descriptive and inferential statistics. The chi-square test, independent t-test, Mann–Whitney U test, repeated measures ANOVA, Kolmogorov–Smirnov test (for examining the normality of the variables), and regression analysis were used for determining the effects of aromatherapy on the hemodynamic indices of the patients.

Results

The chi-square test and t-test revealed that the distribution of socio-demographic variables was not significantly different between the experimental and placebo groups; thus, the two groups were matched in this regard (Table 1). In addition, the t-test and Mann–Whitney U test indicated that the mean values of all variables, except the respiratory rate, before the intervention on the first day were significantly different between the two groups. The Mann–Whitney U test revealed significant differences between the two groups in terms of the mean systolic blood pressure on the second day of the intervention and the mean diastolic blood pressure on the first day of the intervention (P=0.046 0.029, respectively). The t-test revealed no significant difference between the two groups in terms of the mean pulse and respiratory rates after aromatherapy on any day of the intervention (Table 2).

The regression analysis showed that the intervention was group associated with changes in systolic and diastolic blood pressure; the systolic and diastolic blood pressure were lower in the experimental group than in the placebo group (P=0.002 and 0.001, respectively). The blood pressure was not affected by any other interventional variables. In addition, the intervention group, education level, and gender were associated with changes in the pulse rate after the intervention in the experimental group. Thus, the pulse rate was lower in the experimental group than in the placebo group (P=0.0001), higher education level was associated with lower pulse rate (P=0.027), and the pulse rate was lower in women than in men (P=0.045). Moreover, the gender variable was associated with changes in the respiratory rate after the intervention in the experimental group; thus, the respiratory rate was lower in women than in men (P=0.031) (Tables 3 and 4).

Table 1. Distribution of individual characteristics of the patients in two groups

Groups / Variables		N (%)		Sig.
		Placebo	Intervention	
Gender	Female	34 (66.7)	39(60.9)	0.526*
	Male	17 (33.3)	25(39.1)	
Educational status	No education	12 (23.5)	24(37.5)	0.219*
	Primary	14 (27.5)	14(21.9)	
	Under diploma	15 (29.4)	13(20.3)	
	Diplomas	10 (19.6)	10(15.6)	
	Academic	0 (0.0)	3(4.7)	
Marital status	Single	1 (2.0)	1(1.6)	0.780*
	Married	45 (88.2)	54(84.4)	
	Widow	5 (9.8)	9(14.1)	
Location	City	31 (60.8)	32(50.0)	0.248*
	Village	20 (39.2)	32(50.0)	
Employment status	Worker	0 (0.0)	2(3.1)	0.745*
	Staff	2 (3.9)	4(6.2)	
	Free business	15(29.4)	12(18.8)	
	Housewife	16(31.4)	24(37.5)	
	Retired	9(17.6)	10(15.6)	
	Farmer	7(13.7)	10(15.6)	
	Jobless	2(3.9)	2(3.1)	
History of previous hospitalizations	Yes	24(47.1)	30(46.9)	0.984*
	No	27(52.9)	34(53.1)	
History of non-cardiac surgery	Yes	24(47.1)	32(50.0)	0.754*
	No	27(52.9)	32(50.0)	
Age (Mean±SD)		59.80±10.34	59.57±8.49	0.89**

*Chi-square test; **T-test

Discussion

In the study, the difference in the mean systolic blood pressure after the second day of the intervention was significant between the experimental and placebo groups. Kim et al. [26] have also reported the positive effect of lavender essential oil on the blood pressure of individuals. Seong et al. [27] evaluated the short- and long-term effects of inhaling lavender aroma on the systolic blood pressure of the patients and found a decrease in blood pressure after 2 min of inhalation two times a week [27]. Thus, their finding is consistent with our results. Lavender essence stimulates the receptors in the olfactory bulb that transmits the olfactory message to the limbic system [15, 24, 28, 29].

Table 2. Change of the mean of hemodynamic parameters before and after intervention

Hemodynamic Parameters	Groups	Mean±SD							
		Before the Intervention in the First Day		After the Intervention in the First Day		After the Intervention in the Second Day		After the Intervention in the Third Day	
SBP	Placebo	117.04±19.97	P=0.001*	125.92±19.570	P=0.127*	121.12±16.434	P=0.046*	125.31±17.333	P=0.74*
	Intervention	130.31±22.60		120.61±17.696		116.02±15.511		123.47±15.752	
DBP	Placebo	77.76±8.23	P=0.003*	81.02±10.457	P=0.029*	75.51±12.258	P=0.267*	79.39±10.289	P=0.07*
	Intervention	82.65±10.76		75.20±10.799		73.84±8.143		75.51±9.368	
PR	Placebo	84.92±12.63	P=0.003**	86.88±12.412	P=0.772**	83.55±13.393	P=0.960**	81.67±9.752	P=0.84**
	Intervention	93.16±11.79		87.27±11.638		82.76±13.516		82.06±9.666	
RR	Placebo	28.33±6.37	P=0.515**	28.02±5.325	P=0.436**	25.78±5.421	P=0.405**	26.14±4.748	P=0.49**
	Intervention	29.80±7.11		28.04±6.946		27.37±6.379		26.80±4.704	

*Mann-Whitney test; **T-Test

The limbic system is the center of sensation in the brain, which influences the pulse rate, blood pressure, and respiratory system [29, 30], thus causing a decrease in blood pressure. However, all patients who have undergone CABG surgery are also prescribed blood pressure-lowering medicines; therefore, the significant decrease in systolic blood pressure observed in the placebo group on the second and third days compared with the pressure on the first day can be explained as the effect of these drugs. By contrast, Shiina et al. [31] reported that the lavender aroma has no effect on the blood pressure. This discrepancy in the findings may be due to differences in the concentration of the essential oil as they used four drops of lavender essential oil diluted with 20 mL of hot water for aromatherapy. The difference in the mean diastolic blood pressure after the intervention was significant between the two groups, a finding consistent with the results of Heidari et al. [32] who evaluated the effect of inhaling the aroma of lavender essential oil on anxiety and some physiological parameters of patients undergoing open heart surgery. The main sedative compounds of lavender essential oil are linalool and linalyl acetate [33], which stimulate the parasympathetic system [16] as well as the limbic system [29, 30]; this explains the reduction in diastolic blood pressure in

Table 3. Factors associated with changes in pulse rate and respiration rate after aromatherapy in the intervention group

Factors		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95% CI	
		B	Std. Error	Beta			Lower	Upper
PR[1]	Constant	-4.296	6.348		-0.677	0.500	-16.901	8.309
	Group	8.833	2.446	0.335	3.612	0.0001	3.977	13.690
	Educational status	2.400	1.068	0.219	2.248	0.027	0.280	4.520
	Gender	-5.359	2.640	-0.198	-2.030	0.045	-10.601	-0.118
RR[2]	Constant	-1.853	2.156	0.218	-0.859	0.392	-6.131	2.426
	Gender	3.203	1.466		2.185	0.031	0.294	6.112

1. Pulse Rate; 2. Respiratory Rate

Table 4. Factors associated with changes in blood pressure after aromatherapy in the intervention group

Variables		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95% CI	
		B	Std. Error	Beta			Lower	Upper
SBP[1]	Constant	-23.367	7.636		-3.060	0.003	-38.525	-8.209
	Group	15.102	4.830	0.304	3.127	0.002	5.515	24.689
DBP[2]	Constant	-10.408	4.055	0.330	-2.567	0.012	-18.457	-2.359
	Group	8.776	2.565		3.422	0.001	3.685	13.866

1. Systolic Blood Pressure; 2. Diastolic Blood Pressure

the experimental group. By contrast, Bikmoradi et al. [1] reported no significant changes in the hemodynamic indices due to lavender essential oil. This discrepancy in the findings may be explained by differences in the concentration and dose of the essential oil and/or the methods used for measuring these indices between the studies. Bikmoradi et al. used a monitoring device was used to record hemodynamic indices, whereas we used a barometer model ALPK2 to measure blood pressure.

The t-test revealed no significant difference after the intervention on any day between the two groups in terms of the mean pulse and respiratory rates. Consistent with our findings, Seifi et al. [14] reported no statistically significant effect of lavender essential oil on the heart rate and Bikmoradi et al. [1] found no effect of this oil on the respiratory rate.

The regression analysis showed that the intervention group, education level, and gender were associated with changes in the pulse rate and that the gender variable was associated with changes in the respiratory rate after the intervention in the experimental group. This indicated that individuals with higher education levels are more likely to accept changes in physical, mental, and environmental conditions. This explains the effect of lavender essential oil on the hemodynamic indices of these individuals, including the pulse rate. In addition, the relationship between gender variable and changes in the pulse and respiratory rates was possibly due to the difference in the number of women and men between the two groups.

One limitation of the current study was the lack of standard tools for use in aromatherapy. Although the same method of inhalation was used for all patients, the concentration of the essential oil used in our study was higher than that normally used in aromatherapy; this could have caused more effects on the hemodynamic indices.

Nevertheless, the findings of this study showed that lavender essential oil is effective in maintaining blood pressure on the second day of the intervention in patients who have undergone CABG surgery. Future studies are required to evaluate the long-term effects of this oil on the blood pressure of patients by performing aromatherapy at their home after discharge from the hospital.

Ethical Considerations

Compliance with ethical guidelines

Ethics Committee of the Vice Chancellor for Research in Guilan University of Medical Sciences (No: 2930382805, registered in IRCT with No: IRCT2014102119617N1) has confirmed the present paper. Signed written informed consent forms were obtained from the patients, and then the patients were asked to complete the questionnaire.

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Conflict of interest

No conflict of interest has been declared by the authors.

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