Original Article

Effect of lavender essence inhalation on the level of anxiety and blood cortisol in candidates for open-heart surgery

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Abstract

Background: Surgery, as a treatment, is a stressful experience. The anxiety is more severe in open-heart surgery patients due to its risk and complications. The present study aimed to determine the effect of lavender essence on the levels of anxiety and blood cortisol in candidates for open-heart surgery.

Materials and Methods: This was a single-blind clinical trial, a random allocation study with a control group conducted on 90 candidates for open-heart surgery in two groups of study and control. The study and control groups inhaled two drops of lavender and distilled water for 20 min, respectively. Spielberger questionnaire was filled by the patients. A 2 ml blood sample was taken to measure the cortisol level and patients' vital signs were recorded before and after intervention. Data were analyzed by chi-square in the form of mean, SD, and frequency distribution, independent *t*-test, paired *t*-test, and analysis of covariance (ANCOVA), with a significance level of $P = 0.05$ to modify the pre-test scores.

Results: Results showed a significant reduction in mean anxiety score from 56.73 (5.67) to 54.73 (5.42) after intervention in the study group, compared to the control group [1.11 (1.17)] ($P < 0.001$). There was also a higher difference in cortisol level in the study group compared to the control group [1.88 (0.56) vs. 0.42 (0.45)]. ANCOVA test showed that the 10.8% variance in anxiety score and 69.6% decrease in blood cortisol resulted from inhalation of lavender.

Conclusions: Results showed the positive effect of lavender essence on anxiety and blood cortisol level among the patients. Aromatherapy with lavender is suggested to be considered as a nursing intervention in clinical settings.

Key words: Anxiety, cortisol, Iran, lavender essence, lavender essential oil, nursing, open-heart surgery

Introduction

Cardiovascular diseases are known as the most important diseases that cause increased mortality globally. In Iran, based on existing statistics, cardiovascular diseases account for 46% of mortalities.[1] Based on the Ministry of Health and Medical Education report, about 39% of all clients refer to health clinics for circulatory diseases.[2] The most common method to treat cardiovascular diseases is open-heart surgery. About 30,000 open-heart surgeries are annually conducted in various hospitals in Iran.[3] Pre-surgery anxiety is one of the common problems that the patients face. Surgical procedures, ignoring their difficulty, are all horrific and are often associated with fear of no anesthetic recovery, fear of the operating room, and post-anesthetic pain.[4] Pre-surgery anxiety stimulates the sympathetic, parasympathetic, and endocrine systems and leads to higher heart rate, increased BP, and cardiac irritability, and results in arrhythmia.[5] Anxiety is more severe and even

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sometimes overcomes the patient in open-heart surgery due to its risks, complications, and prognosis.[3] Anxiety and depression have been reported in 25–30% of the patients before coronary by-pass surgery. Anxiety increases cortisol and adrenalin serum levels as a physiological response of the body to stress. The complications associated with increased cortisol level are destruction of cognitive function, destruction of thyroid function, an imbalance in blood sugar such as hyperglycemia, hypertension, suppression of the immune system and inflammatory responses in the body, delayed wound recovery, and reduction of muscular mass.[6]

Numerous medicational and non-medicational methods are used to lower anxiety. Many of the non-medicational methods that are nowadays adopted are categorized as complementary medicine treatments. One of the treatments, which has been popular in recent years compared to other complementary medicine treatments for anxiety in most of the countries, is aromatherapy, the second complementary treatment used by nurses in clinical setting.[7] Aromatherapy refers to inhalation, massage, and inhaling the vapor of volatile essence of plants and grasses to prevent or treat a disease.[8] Lavender is a herb used in traditional medicine from ancient times. This plant belongs to the scented group of mints and grass and is always green, and has anti-depression, antibacterial, anti-fungal, carminative, muscle relaxant, and pain killing properties.[7,9] Its positive effects have been investigated in several studies. They include reduction of anxiety before abdominal surgeries,[7] reduction of menstrual cramps and dysmenorrhea,[10] reduction of anxiety among the patients undergoing coronary artery angiography,[11] and reduction of anxiety among the patients with cancer.[12] No previous studies were conducted on the effect of this essence on anxiety of open-heart surgery patients and no side effects due to consumption of lavender have been reported in studies conducted in humans.[13] Therefore, the present study aimed to determine the effect of lavender essence inhalation on the level of anxiety and blood cortisol in candidates for open-heart surgery.

Materials and Methods

This was a single-blind clinical trial with random allocation and a control group (type of essence was unknown for the patients) that was conducted on 90 candidates for open-heart surgery in two groups of intervention ($n = 45$) and control ($n = 45$) in Amir-al-Momenin hospital in Kord Kouy in 2012.

Random allocation of the subjects to inhale either lavender or distilled water was conducted by using random number table in SPSS 16. Inclusion criteria were: Subjects over 18 years of age, no addiction to drugs, no history of allergy to plants, no consumption of psychiatric medicines and anti-anxiety agents, and no consumption of corticosteroid drugs within 3 months prior to the study. The subjects were excluded if they could not tolerate the lavender essence, were transferred to the operating room before finalizing the intervention, or had lost interest to remain in the study.

Measurement of anxiety was conducted by making the patients fill the spielberger anxiety questionnaire and by measurement of cortisol levels before and after intervention. Data were collected by a checklist including baseline characteristics (age, sex, level of education, marital status, race, and history of previous surgeries) and clinical characteristics (vital signs, spielberger questionnaire score, and plasma cortisol levels before and after intervention); spielberger anxiety questionnaire, cortisol measurement kit, a manometer and measurement of the rate of patients' respiration through observation of their chest and their pulse by radial artery were used for collecting data.

Spielberger anxiety measurement questionnaire contains two sections of overt and hidden anxiety measurement.

The section for overt anxiety was adopted in the present study. It includes 20 items in Likert's scale associated with strait–trait transitive emotions, which are scored as either negative or positive. Each item is scored from 4 to 1 in a positive and from 1 to 4 in a negative form. The scores range between 20 and 80, in which the scores 20–39 show minor anxiety, the scores 40–59 show moderate anxiety, and the scores 60–80 show major anxiety. Validity and reliability of this questionnaire were confirmed in domestic studies including Mahram, which focused on accreditation of spielberger anxiety test and was conducted on 600 subjects in the form of a student thesis.[14] To measure plasma cortisol level, Monobind cortisol kit made in USA (Monobind Inc., CA, USA) was used. Its sensitivity was 62.5 pg (equals to 0.25 μg/dl), which was achieved by 10 measurements to clarify standard zero with a confidence interval of 95% (2 SD). At the most, one qualified patient entered the study on every single day of sampling. In the morning of the surgery, necessary explanations concerning confidentiality of patients' information, their voluntary participation, and the research goals, stages, and length were given to the patient. Then, after the patients signed the informed consent forms, their demographic characteristics and vital signs were recorded by the researcher. Spielberger anxiety questionnaire was also filled by the patient. A 2 ml blood sample was taken to measure plasma cortisol level. Next, two drops of lavender essence (made by Kashan Barich essence company) and two drops of distilled water were

taken in a sterile gauze for the study and control groups, respectively, and the subjects were asked to inhale them for 20 min.[9,15] Five minutes after intervention, the process of vital signs measurement, filling spielberger questionnaire, and taking another blood sample was repeated. During the intervention, the accompanying persons of the patients remained out of the intervention room, were given adequate explanations, and were assured about the risk-free intervention. If more than one qualified patient was admitted, they would be hospitalized in separate rooms, but under identical conditions (temperature, light, noise, number of patients in the room) with the coordination of the ward head nurse. At the end of intervention, the type of essence and the goal of study were explained to the patients, and the control group received a gauze containing lavender essence to inhale if they requested. Sampling went on from Jan to Oct 2012 (5 months). The intervention was administered between 7:30 and 8:30 AM on the day of surgery. The blood sample was centrifuged in the laboratory of the hospital and the obtained plasma was transferred to the biochemistry laboratory of Golestan University of Medical Sciences in an ice pack and kept frozen at –20°C under the supervision of an expert, until completion of blood sampling. This project was registered in the clinical trial center (IRCT 201202068929N1) and approved by the research ethics committee of Golestan University of Medical Sciences (g/p/35/340). Existence of variables such as different levels of understanding, culture, beliefs, and religious beliefs that could affect subjects' and their relatives' anxiety can be counted as the limitations in the present study. The score of the questionnaire was calculated by mean and SD. Normal distribution of anxiety and plasma cortisol level scores were proved by Shapiro–Wilk and Kolmogorov–Smirnov tests. Levene's test was adopted to check the homogeneity of variances of anxiety scores in the two groups.

Paired *t*-test was adopted for comparison of before–after intervention and independent *t*-test was used to compare the two groups. Analysis of covariance (ANCOVA) was used to reduce the effect of anxiety score before intervention. In all statistical tests, significance level was considered as $P < 0.05$.

Results

In the study group, there were 29 male (64.4%) and 16 female (35.6%) subjects. In the control group, there were 26 male (57.8%) and 19 female (42.2%) subjects. Subjects' age ranged between 22 and 69 years with mean (SD) of 50.49 (10.93) and 50.13 (9.20) years in the study and control groups, respectively. About 77.7% in the study group and 82.2% in the control group were of Persian race, 60% in the study group and 68.8% in the control group had education level lower than high school, and over 90% of the subjects were married in both groups. Frequency distribution of sex, age, racial group, education, and marital status showed no significant difference before intervention between the two groups.

Independent *t*-test showed no significant difference in anxiety scores in the two groups before intervention. Mean (SD) of anxiety before and after intervention were 56.73 (5.67) and 54.73 (5.42), and 55.18 (7.35) and 54.07 (7.22) in the study and control groups, respectively. Paired *t*-test showed a significantly higher reduction in mean anxiety score in the study group compared to control [2.00 (1.26) vs. 1.11 (1.17); $P < 0.0001$] [Table 1]. Mean plasma cortisol levels showed no significant difference in the two groups before and after intervention. But paired *t*-test showed that the reduction of cortisol levels from 16.76 to 14.88 in the study group and from 16.19 to 15.77 in the control group was significant ($P < 0.001$). As the difference was significant in both groups, the mean difference was calculated in the two groups. Analysis of mean cortisol levels in the two groups by independent *t*-test showed a higher mean difference before and after intervention in the study group compared to the control group [1.88 (0.56) vs. 0.42 (0.42); $P < 0.001$] [Table 2]. The values of previous stage scores of anxiety, systolic and diastolic BP, pulse, and respiration rate of the patients were entered as covariates in ANCOVA, and with regard to confirmation of homogeneity of regression slope and concurrent effect of covariates, the effect of intervention in reduction of anxiety was clarified. In addition, it was revealed that 10.8% of anxiety score variance resulted from the intervention ($\eta^2 = 0.108$, $P = 0.002$, df = 1, f = 10.003)

Table 1: Comparing the mean and standard deviation scores of Spielberger questionnaire obtained by the inyervention and control groups

Group	Mean (standard deviation)		Difference between before and after	
	Before	After	$\bar{X}$±SD	*P* value
Intervention	5/67±56/73	5/42±54/73	1/26±2/00	0/001
Control	7/35±55/18	7/22±54/07	1/17±1/11	
t test	NS	NS	-	

Table 2: Comparing the mean and standard deviation level of plasma cortisol of open- heart surgery patients in μg/ml

Group	Mean (standard deviation)		Difference between before and after	
	Before	After	$\bar{X}$±SD	*P* value
Intervention	16/76±2/39	14/88±2/21	1/88±0/56	0/001
Control	16/19±2/90	15/77±2/84	0/45±0/42	
t test	NS	NS	-	

(η^2 refers to the adequacy value) [Table 3]. Patients' cortisol levels, systolic and diastolic BP, pulse, and respiration rate before the intervention stage were entered as covariates in ANCOVA, and with confirmation of regression slope and concurrent effect of covariates, the positive effect of intervention on reduction of cortisol level was observed. About 70% of cortisol level variance resulted from the intervention, which shows that after controlling the effect of cortisol level before intervention, about 70% reduction in cortisol level was due to lavender ($\eta^2 = 0.696$, $P = 0.002$, df =1, f = 190.042) [Table 4].

Results showed a significant decrease in mean systolic BP, pulse, and respiration rate after intervention in the two groups, compared to before intervention ($P = 0.001$), but the mean difference was not significant before and after intervention between the two groups. Results showed a significant correlation between the plasma cortisol level and the anxiety score before intervention (r =0.566, $P < 0.001$) as well as after intervention (r = 0.536, $P < 0.001$). In fact, the subjects with higher plasma cortisol obtained higher scores in spielberger anxiety questionnaire (which shows their higher anxiety). There was a significant correlation between mean difference of plasma cortisol and anxiety score (r = 0.355, $P < 0.001$).

Discussion

The present study investigated the effect of lavender essence on the level of anxiety and blood cortisol in candidates for open-heart surgery.

The findings showed that overt and general anxiety levels significantly diminished in both study and control groups, although the decrease was more in the study group compared to control. Aromatherapy had no effect on systolic BP, pulse, and respiration rate. In the study of Babashahi *et al*., the effect of inhalation aromatherapy on patients' anxiety before surgery was investigated by giving the study group two drops of lavender to inhale for 20 min.[9]

In their study, the mean anxiety level showed a significant reduction in the study group after intervention, compared to the control group, which is in line with the present study findings, although the difference was not significant in their control group, which is inconsistent with the present study results. The reason might be due to the type of surgery. In their study, most of the subjects underwent laparotomy, while in the present study, most of the subjects underwent open-heart surgery. In addition, the difference before and after intervention was not measured in their study, while in the present study, paired *t*-test was used to compare the difference before and after intervention and to investigate the efficacy of intervention. In Babashahi *et al.*'s study, the mean difference of spielberger score showed a significant difference between the two groups, which is in line with the present study results. In their study, there was no significant difference in the mean values of pulse and respiration rate, which is consistent with the present study.[7] Kanaani *et al*., in a study on the effect of lavender aromatherapy on the anxiety of the patients undergoing hemodialysis, reported a significant reduction in overt anxiety of the subjects who inhaled lavender essence, compared to before intervention, which is consistent with the present study. Meanwhile, the findings in their control group are inconsistent with those of the present study, possibly due to the length of intervention administration. Intervention lasted for 4 weeks in Kanaani *et al.*'s study, which led to more precise attention by the patients while filling the questionnaire. Meanwhile, in the present study, the subjects filled the questionnaire before and after a 20-min intervention. The other reason might be associated with the psychological aspect of intervention. As open-heart surgery patients experience a higher level of anxiety, any attendance and intervention made by the medical team members leads to more peace and trust and lesser anxiety among patients.[16] Cho *et al*. concluded that aromatherapy led to lower anxiety in the patients undergoing percutaneous coronary intervention (PCI).[17] In the study of Muzzarelli *et al*. on the effect of aromatherapy and reduction of anxiety before the procedure, no difference was observed between the anxiety levels before and after intervention in the study and control groups, which is inconsistent with the present study findings, possibly due to the different methods used in the studies. In Muzzarelli *et al.*'s study, the study group inhaled three drops of diluted lavender essence and grape seed oil for 5 min, while in

Table 3: Results of analysis of covariance to examine the factors influencing anxiety scores after intervention in open-heart surgery patients

Sources of change	Sum of squares	df	Mean square	F	Significance level	Effect size
Anxiety score before intervention	2974.497	1	2974.497	2134.841	0.001	0.963
Group	13.937	1	13.937	10.003	0.002	0.108

Table 4: Results of analysis of covariance to examine the factors affecting cortisol levels after intervention in open-heart surgery patients

Sources of change	Sum of squares	df	Mean square	F	Significance level	Effect size
Cortisol levels before intervention	394.852	1	394.52	1669.483	0.001	0.953
Group	44.947	1	44.947	190.042	0.001	0.696

the present study, the study group inhaled two drops of lavender for 20 min.[18] Mirzaei *et al*. reported a significant reduction in anxiety level of the study group (based on spielberger questionnaire) compared to the control group, as well as a reduction in anxiety level after aromatherapy compared to before, which is consistent with the present study results. In addition, they also concluded that there was a significant correlation between reduction in the level of cortisol and reduction of anxiety.[19] Our study showed that aromatherapy led to a reduction in cortisol level. Yamada *et al*. reported that aromatherapy resulted in a reduction of adrenocorticotropic hormone secretion and, consequently, reduction of cortisol level.[20] Results of Muzzarelli *et al*., Shiina *et al*., and Hwang emphasized on the direct effect of aromatherapy on reduction of cortisol level.[18,21,22]

Conclusion

In conclusion, the present study showed that inhalation of lavender could reduce the level of anxiety and cortisol in open-heart surgery patients before surgery. Therefore, aromatherapy with lavender can be adopted as a branch of complementary medicine to control anxiety before surgeries in clinical settings.

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Conflicts of interest

There are no conflicts of interest.

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