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The effect of aromatherapy with peppermint essential oil on anxiety of cardiac patients in emergency department: A placebo-controlled study

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ABSTRACT

Introduction: Anxiety is an unpleasant feeling that increases the myocardial oxygen demand in acute coronary syndrome. This study aimed to evaluate the effect of peppermint aromatherapy on anxiety in patients with acute coronary syndrome in the emergency department.

Materials and methods: In this clinical trial study, 64 patients with acute coronary syndrome were randomly divided into intervention and control groups. In the intervention group, a cotton ball was soaked in 100% peppermint essential oil and placed about 20 cm from the patient's nose for 1 h while in the control group, the cotton ball was soaked in water. Anxiety was measured before and after the intervention with The Spielberger state-trait anxiety inventory. The data were analyzed in SPSS ver.23 software.

Results: No significant difference was observed between the two groups in terms of patients' demographic data. The mean score of trait and state anxiety before the intervention was not significantly different between the two groups. After the intervention, anxiety was significantly lower in the intervention group (37.72 ± 10.41) compared to the control group (42.62 ± 5.99) ($P = 0.021$). Results indicated a significant decrease in anxiety after the intervention ($P < 0.001$) in the intervention group. Such a difference was not significant in the control group.

Conclusion: Peppermint essential oil inhalation significantly reduces anxiety of patients with acute coronary syndrome in emergency department.

1. Introduction

Accounting for 15.9% of all deaths, coronary artery and ischemic heart diseases are among the main causes of death in the world [1]. According to the World Health Organization (WHO), ischemic heart diseases caused over nine million deaths until 2016, and are anticipated to cause 30.5% of deaths worldwide by 2030 [2]. Due to a recent focus on prevention and improvement of diagnostic and treatment modalities, the mortality rate of heart diseases has dramatically reduced in Western countries, but in developing countries such as Iran, ischemic heart diseases still remain a serious health challenge. In the Eastern Mediterranean countries, Iran has the highest statistics of heart diseases [3].

The severity of clinical signs of acute coronary syndrome (ACS) and its threatening nature are such that they affect the patients' physical ability as well as mental status, and many patients experience high levels of anxiety in the first 24 h of developing ACS [4,5]. Review of literature suggests that 20%–60% of the patients suffer anxiety after developing ACS [6,7]. This anxiety is worse in the early stages of the disease in the emergency department, when patients experience the severest clinical signs than when they have a stable condition and are admitted to the ward [8].

Patients admitted to the emergency department with cardiac signs experience difficult conditions. Among the main factors that cause anxiety in emergency department are waiting for the diagnosis, fear of dying, chest pain, and unknown medical status and care procedures [9]. Anxiety is a major complaint of patients with chest pain. Review of literature shows that 31%–56% of the patients with chest pain suffer anxiety [10,11]. Diagnosis and treatment of ACS in emergency department depends on clinical examinations and laboratory findings rather than on subjective evaluations. Thus, as an important principle in

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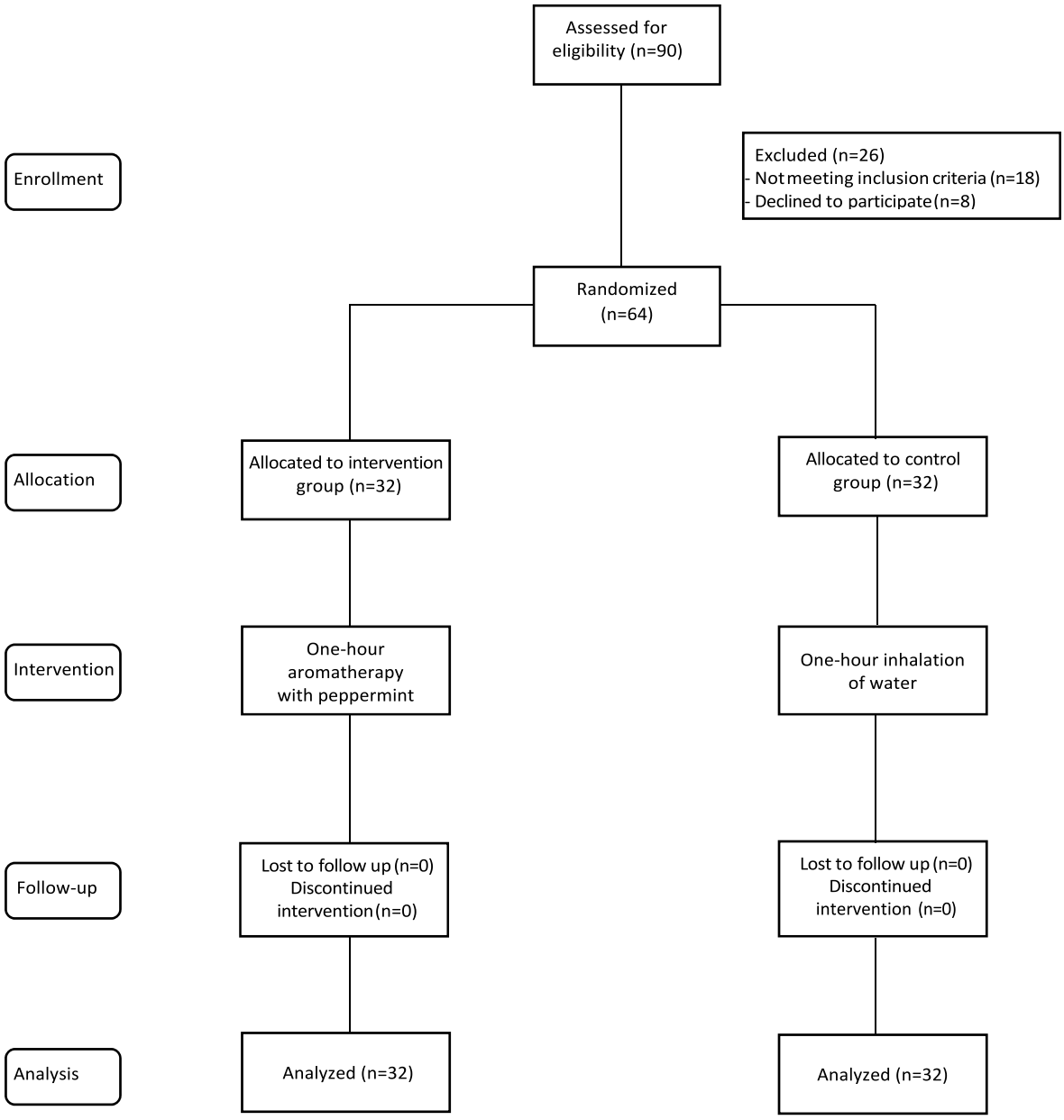

Fig. 1. CONSORT flow diagram of the study.

patient management in emergency departments, reducing patient's anxiety does not interfere with diagnosing the disease [10].

Anxiety can increase the plasma concentrations of epinephrine and norepinephrine, which affect physiological indicators such as blood pressure, pulse rate and respiration rate, and increase myocardial oxygen uptake, therefore, anxiety is regarded as one of the causes of disease progression and exacerbation of clinical signs [12]. The first key measure in the care and treatment of ACS is to reduce the myocardial oxygen demand [13].

It is hugely important in emergency department to use simple non-pharmacological modalities with fewer complications for reducing patients' anxiety while preventing the masking of clinical signs during diagnosis and treatment approaches. These methods can effectively comfort patients and help them tolerate emergency situations without disrupting the diagnosis.

Aromatherapy is one of the simple and effective methods for treating anxiety. Aromatherapy involves the use of psychological, physiological and medicinal effects of essential oils to improve the patient's condition. Some specialists regard aromatherapy as a kind of holistic intervention that heals body and soul while others consider aromatic compounds and essential oils medicinal elements and try to assess their performance in medical therapies [14].

Essential oils are extracted from different parts of plants, including flowers, roots and leaves, and can help improve patients' physical health, mental health, and quality of life [15]. Aromatherapy can positively regulate emotions, control anxiety, reduce depression, and stimulate or strengthen memory [17–19]. The role of aromatherapy in reducing anxiety can be attributed to its effect on the limbic system, hypothalamus and piriform cortex [16].

Inhaled peppermint essential oil is systemically absorbed through the nasal mucosa and the lungs. Only a few minutes after inhaling peppermint aroma, its molecules appear in the blood, and then in the brain and nervous system because of being lipophilic. Peppermint is well known for its antispasmodic, analgesic, anti-inflammatory, anti-congestion and antioxidant properties [17]. Peppermint extract is a light yellowish green liquid with a pungent scent and taste, obtained by

distilling its flowers and fresh shoots. This liquid contains *menthol*, *menthone*, and *menthyl acetate* [18]. The results of a study showed that peppermint can reduce anxiety in patients with myocardial infarction [19]. Another study showed that peppermint reduces anxiety during childbirth [20].

Given that ACS is one of the main reasons for presenting to emergency department, and almost all patients with this syndrome experience some degrees of anxiety in emergency department, controlling patients' anxiety under these circumstances is highly important. Purpose of this study was to determine the effectiveness of inhaled peppermint on anxiety of patients with ACS.

2. Material and methods

2.1. Study design and participants

The present study is a placebo-controlled study in which 64 patients with ACS attending the emergency department of Chamran Hospital in Tehran to receive medical care were selected as samples. The inclusion criteria included diagnosis of ACS by an emergency medicine specialist, 40–75 years of age, with a healthy olfactory sense, no known mental disorders, and reading and writing literacy.

The exclusion criteria included history of respiratory allergies, life-threatening conditions such as life-threatening arrhythmias and hemodynamic disorders. The olfactory health was assessed by a cotton swab dipped in lemon juice.

Sample size was estimated 26 individuals per group using the mean difference formula for two independent populations, based on a study by Vaezi et al. (2017) that reported mean and standard deviation of patients' anxiety 45.5 ± 4 in the intervention group and 50.14 ± 5.9 in the control group [25] in STATA with 95% confidence interval, 90% test power, and according to the two-tailed test. Sample size was raised to 32 individuals per group to cover possible sample loss.

Convenient sampling was conducted based on the inclusion and exclusion criteria until reaching the required sample size. Patients were assigned to two groups using stratified permuted block randomization, such that patients were divided into groups based on being male or female. Random allocation of patients was carried out for each stratum separately using the computerized table of random numbers.

The present study was approved by the Ethics Committee of Semnan University of Medical Sciences (Code: IR.SEMUMS.REC.1397.117). Necessary arrangements were made with an emergency medicine specialist before patients entered the study. Patients signed informed written consent knowing the voluntary nature of participation and that not participating in the study would not affect receiving medical and care services. Before patient enrollment, the trial was registered at the Iranian Registry of Clinical Trials (IRCT), No: IRCT20110430006342N7.

In the peppermint group, three drops of peppermint essential oil (100%, diluted 1:20 with sweet almond oil) (Zardband Pharmaceuticals, Iran) were poured on a cotton ball, and placed on the patient's collar, 20 cm away from their nose [25]. Then, the patients were asked to breathe gently for 1 h. In the placebo group, three drops of water were poured on a cotton ball, and placed on the patient's collar for 1 h.

2.2. Measurement

The patients' anxiety was assessed using the Spielberger's State-Trait Anxiety Inventory (STAI), which was completed by the patients before the intervention while the state anxiety subscale was completed again 1 h after the intervention (Fig. 1).

For state anxiety items, patients report how they feel right now by rating the intensity of their anxiety feelings on a 4-point Likert scale [1]: very little [2], little [3], much, and [4] very much. For trait anxiety items, patients report how they "generally" feel by rating themselves on a 4-point Likert scale [1]: almost never [2], sometimes [3], often, and [4] almost always. Spielberger's State-Trait Anxiety Inventory (STAI) has appropriate validity and reliability, and has been frequently used in clinical research in Iran [13,21,22]. In a study by Ozgoli, reliability of this questionnaire was confirmed with Cronbach's alpha coefficient of 0.88 [20]. In the present study, its reliability was assessed and confirmed with Cronbach's alpha coefficient of 0.82.

Data were analyzed in SPSS (Statistical Package for Social Sciences, version 23.0) at the significance level of 0.05. Chi-square test was used to compare the categorical variables in the two groups. The t-student test and analysis of variance (ANOVA) were used to compare patients' anxiety scores, and paired *t*-test was used to compare patients' anxiety scores before and after the intervention in the two groups.

Table 1
Demographic characteristics of participants.

		Intervention		Control		P-value[a]
		No	%	No	%	
Sex	Male	16	50	16	50	>0.999
	Female	16	50	16	50	
Marital status	Single	4	12.5	5	15.6	0.71
	Married	28	87.5	27	84.4	
History of previous illness	Yes	12	37.5	21	65.6	0.104
	No	20	62.5	11	34.4	
Education level	Primary	3	9.4	1	3.1	0.121
	Middle	6	18.8	14	43.3	
	High School	1	3.1	7	21.9	
	Diploma	16	50	8	25	
	University	6	18.8	2	6.2	
Age (Year)	> 60	16	50	16	50	[b]0.904
	< 60	16	50	16	50	

[a] Chi-Square.
[b] T-Test.

Table 2
Comparison of mean state anxiety in two groups.

	Intervention		Control		P-value[a]
	Mean	SD¥	Mean	SD	
state anxiety before	46.50	11.43	42.84	6.46	0.12
state anxiety after	37.72	10.41	42.62	5.99	0.02
P-value[b]	<0.001		0.315		

¥ Standard Deviation.
[a] *t*-student test.
[b] Paired *t*-test.

3. Results

The patients' mean age was 62.88 ± 8.35 years in the peppermint group and 62.12 ± 8.17 years in placebo group, with no significant difference between the two groups (P = 0.904). The patients' demographic details are presented by group in Table 1.

The patients' trait anxiety was 45.53 ± 8.493 in the intervention group, and 43.34 ± 6.323 in the control group, and independent *t*-test showed no significant difference between the two groups (P = 0.24). No significant difference was observed between the two groups before the intervention in state anxiety (P = 0.12), but their difference was significant after the intervention (P = 0.02). Furthermore, assessing state anxiety in the two groups before and after the intervention showed a significant difference in anxiety before and after the intervention in the intervention group (P < 0.001), but not in the placebo group (Table 2). Table 3 demonstrates the results of an ANOVA comparing both groups pre to post intervention for state anxiety. As can be seen in Table 3, the main effect of time and the interaction effect of time and group are both significant (P < 0.001). Mean respiration rate in two groups before and after the intervention was significantly different, but no significant difference was observed in other vital signs (Table 4).

Table 3
Results of an ANOVA comparing both groups pre to post intervention for state anxiety.

Source of Effects		Sum of Squares	df[a]	Mean Square	F	P
Within-Subjects	Time	648.000	1	648.000	46.800	<.001
	Time × Group	586.531	1	586.531	42.360	<.001
	Error (Time)	858.469	62	13.846		
Between-Subjects	Intercept	230350.781	1	230350.781	1593.284	<.001
	Group	12.500	1	12.500	.086	.770
	Error	8963.719	62	144.576		

[a] Degree of freedom.

Table 4
Mean difference of vital signs of patients in the two groups before and after intervention.

	Intervention Mean ± SD	Control Mean ± SD	P value[a]
Pulse rate (per min)	0.13 ± 2.59	−0.16 ± 2.55	0.664
Systolic BP (mmHg)	−3.03 ± 21.48	−2.37 ± 8.57	0.873
Diastolic BP (mmHg)	−0.09 ± 7.95	−0.62 ± 3.73	0.734
Respiratory Rate (per min)	0.18 ± 0.53	−0.03 ± 0.17	0.034
Temperature	−0.01 ± 0.07	0.08 ± 0.53	0.269
SPO2 (%)	−0.31 ± 0.69	−0.12 ± 0.42	0.197

[a] *t*-student.

4. Discussion

The present study investigated the effect of inhaling peppermint essential oil on anxiety of patients in the emergency department. Crowded environment, presence of critically ill patients, and anxiety inducing conditions in the emergency department has an overwhelming effect on patients, especially patients with cardiac diseases. Studies report the main causes of patients' anxiety as fear of death and heart attack, which cause high levels of anxiety and can increase the risk of death by threefold. Thus, reducing patients' anxiety, especially in the emergency department, is one of the treatment priorities of cardiac patients.

According to the results, the mean score of state anxiety after the intervention was 40.17 ± 8.78, which was significantly lower in the peppermint group (37.72 ± 10.41) compared to the placebo group (42.63 ± 5.99) (P = 0.021). The difference in anxiety before and after the intervention was significant in the peppermint group (P < 0.001), but not in the placebo group. Ozgoli et al. (2016) conducted a study to compare the effects of aroma of extracts of clove and peppermint on anxiety in patients in the first stage of labor, and reported trait anxiety reduced in both groups, but this reduction was higher in the clove group compared to the peppermint group [20].

Iranian families use peppermint as a traditional substance to control gastrointestinal symptoms. Since it is mentally familiar and acceptable for patients, they tolerate it better than other compounds such as clove extract.

Vaezi et al. (2016) investigated the effect of inhaling peppermint extract on anxiety of patients with heart attack in cardiac care unit, and reported that peppermint extract can reduce anxiety in patients with heart attack [19]. In agreement with the present study results, in their study titled "The effect of aromatherapy on anxiety of patients before coronary artery bypass graft surgery", Pourmovahed et al. (2016) concluded that the mean score of anxiety reduced in the intervention group [23]. Finding of Koohestani's study showed aromatherapy with the inhalation of peppermint aroma has been effective in reducing anxiety in patients undergoing coronary angiography [24]. Mahdavikian et al. (2020) demonstrate aromatherapy with peppermint essential oil can improve the sleep quality of cardiac patients [25]. Mogharab et al. (2017) examined the effect of inhaling peppermint on anxiety of patients undergoing colonoscopy, and reported that inhaling peppermint reduced anxiety in these patients, which concurs with the present study results [26].

Akbari et al. (2019) investigated the effect of peppermint on anxiety of cardiac patients and concluded that peppermint had no effect on anxiety of these patients, and that the two groups were not significantly different after the intervention [27]. The ineffectiveness of peppermint appears to be related to the short duration of intervention (5 min). In addition, anxiety was measured using VAS in their study. In the present study, patients received 1 h of aromatherapy and anxiety was measured using Spielberger's STAI.

Our results also showed a difference in the mean changes in respiration rate before and after the intervention in the two groups (P = 0.034). However, no significant difference was observed in the mean changes after the intervention in other vital signs in the two groups. Kato et al. (2018) investigated the relationship of anxiety with respiratory parameters in healthy people, and reported that people with a higher anxiety have higher respiration rates and shorter inhalation and exhalation time, but no changes in the heart rate, level of end-tidal carbon dioxide (ETCO2), and level of oxygen absorption [28]. It appears that breathing is somewhat affected in mild anxieties, and other vital signs are affected with increasing anxiety. In the present study, patients' anxiety was mild, and only respiration rate changed while variables such as heart rate and blood pressure were not affected.

The present study results and review of other similar studies showed that inhaling peppermint can significantly reduce anxiety of patients with ACS. In traditional medicine, mint is used as an analgesic, antiseizure, and sedative [29]. The most active ingredient in peppermint extract is menthol and menthol esters comprise about 30%–70% of volatile peppermint essential oil. By stimulating the olfactory pathways, and affecting the hypothalamus, menthol in peppermint reduces the secretion of corticotropin-releasing hormone, adrenocorticotropin from the pituitary gland, cortisol from the adrenal gland, and ultimately anxiety [13]. In a study by Towda et al. (2011), aromatherapy with peppermint reduced cortisol and chromogranin levels in patients [30].

The effect of peppermint aroma can be partly attributed to patient's familiarity with its nostalgic feeling that associates it with home care. In Iran, peppermint is traditionally used as a syrup, extract, and distilled drink. Further studies are needed on the phytochemistry and pharmacology of peppermint to better understand its mechanism of action, duration and dosage required to reduce patients' anxiety.

The study limitations included the patients' mental status and environmental conditions, which affected their anxiety. Although we tried to communicate with patients in a controlled and similar manner, their communications with their family and accompaniments, and their mental status were beyond researcher's control. Using a single time inhalation is another limitation of the study.

Declaration of competing interest

This research is sponsored by Semnan University of Medical Sciences.

The authors report no conflict of interest.

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