Clinical Trial Protocol
Iranian Registry of Clinical Trials

07 Nov 2026

Investigating the Effect of Inhalational Aromatherapy with Lemon Essential Oil on Hemodynamic Stability, Inflammatory Markers, Sedation, Sleep Quality, and Delirium in Patients Undergoing Open-Heart Surgery

Protocol summary

Study aim

Determining the effect of inhalation aromatherapy with lemon essential oil on hemodynamic stability, inflammatory markers, sedation level, sleep quality, and the incidence of delirium in patients undergoing open-heart surgery.

Design

prospective, parallel-group, triple-blind randomized controlled clinical trial involving 104 patients, allocated equally to two groups (52 per group) using block randomization with blocks of four. The random sequence will be generated using the RAND function in Microsoft Excel. Ethics code: IR.SBMU.PHARMACY.REC.1405.183.

Settings and conduct

The study will be conducted at Shahid Modarres Hospital, Tehran. Eligible patients will be randomized to lemon essential oil or placebo. Hemodynamic, inflammatory, sedation, sleep, and delirium outcomes will be assessed for up to 72 hours postoperatively. Patients, assessors, and the statistician will be blinded.

Participants/Inclusion and exclusion criteria

Inclusion: Age 40–80 years; elective open-heart surgery (especially CABG); ASA I–III; adequate consciousness, orientation, and verbal communication; written informed consent. Exclusion: Allergy to lemon essential oil or herbal products; olfactory dysfunction or nasal obstruction; severe active psychiatric disorder; personal or family history of postoperative delirium; concurrent participation in a similar trial.

Intervention groups

Intervention group: Inhalation of five drops of lemon essential oil every two hours, from the night before surgery until 24 hours postoperatively, except during general anesthesia and mechanical ventilation. Control group: The same protocol using odorless bitter almond oil as a placebo.

Main outcome variables

Hemodynamic parameters; C-reactive protein (CRP), serum cortisol, and neutrophil-to-lymphocyte ratio; incidence and severity of delirium (ICDSC); sedation level (RASS); sleep quality (RCSQ).

General information

Reason for update

Acronym

IRCT registration information

IRCT registration number: **IRCT20231021059795N3**
Registration date: **2026-10-26, 1405/08/04**
Registration timing: **prospective**

Last update: **2026-10-26, 1405/08/04**
Update count: **0**

Registration date

2026-10-26, 1405/08/04

Registrant information

Name

Maryam Aligholizadeh

Name of organization / entity

Country

Iran (Islamic Republic of)

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Recruitment status

recruiting

Funding source

Expected recruitment start date

2026-11-06, 1405/08/15

Expected recruitment end date

2027-03-06, 1405/12/15

Actual recruitment start date

empty

Actual recruitment end date

empty

Trial completion date

empty

Scientific title

Investigating the Effect of Inhalational Aromatherapy with Lemon Essential Oil on Hemodynamic Stability, Inflammatory Markers, Sedation, Sleep Quality, and Delirium in Patients Undergoing Open-Heart Surgery

Public title

Effect of Inhalational Aromatherapy with Lemon Essential Oil in Patients Undergoing Open-Heart Surgery

Purpose

Prevention

Inclusion/Exclusion criteria

Inclusion criteria:

Age between 40 and 80 years Scheduled for elective open-heart surgery, particularly coronary artery bypass grafting (CABG). American Society of Anesthesiologists (ASA) physical status class I–III Adequate consciousness, orientation to time, place, and person, and intact verbal communication at the time of consent Provision of written informed consent.

Exclusion criteria:

1. Known allergy to lemon essential oil or the herbal preparations used in the study. Olfactory impairment or nasal obstruction interfering with adequate inhalation Active severe psychiatric disorder that may interfere with outcome assessment Personal or family history of postoperative delirium Concurrent participation in a similar clinical trial.

Age

From **40 years** old to **80 years** old

Gender

Both

Phase

3

Groups that have been masked

No information

Sample size

Target sample size: **104**

Randomization (investigator's opinion)

Randomized

Randomization description

Following convenience sampling and eligibility assessment, patients will be individually randomized in a 1:1 ratio to the intervention or control group using block randomization with a block size of four. The random sequence will be generated using the RAND function in Microsoft Excel. Allocation will be concealed using identical, opaque, sealed envelopes bearing unique codes. Intervention preparation and coding will be performed by an independent research team member.

Blinding (investigator's opinion)

Triple blinded

Blinding description

Participants, healthcare staff responsible for their care, and data analysts will remain unaware of the group allocation. Participants will be informed that they will receive a pleasant, neutral scent as part of their care, without the specific type of essential oil being disclosed. Lime essential oil (the intervention) and bitter almond essential oil (the control) will be diluted to the same concentration, placed in coded bottles that are identical in appearance and packaging, and prepared by an independent anesthesiologist. Bitter almond essential oil is used as a control due to its mild scent. Outcome assessments will be conducted by blinded intensive care unit staff. Data will be entered into SPSS software using anonymized codes, and the identities of the groups will be revealed only after the statistical analysis is complete.

Placebo

Used

Assignment

Parallel

Other design features

Secondary Ids

empty

Ethics committees

1

Ethics committee

Name of ethics committee

Faculties of Pharmacy, Nursing, and Midwifery – Shahid Beheshti University of Medical Sciences

Street address

Valiasr Street, intersection with Ayatollah Hashemi Rafsanjani Highway, opposite the Cardiovascular Hospital.

City

Tehran

Province

Tehran

Postal code

1996835119

Approval date

2026-07-17, 1405/04/26

Ethics committee reference number

IR.SBMU.PHARMACY.REC.1405.183

Health conditions studied

1

Description of health condition studied

Hemodynamics

ICD-10 code

-

ICD-10 code description

-

2

Description of health condition studied

Inflammatory markers

ICD-10 code

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ICD-10 code description

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3

Description of health condition studied

Sedation

ICD-10 code

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ICD-10 code description

.

4

Description of health condition studied

Sleep Quality

ICD-10 code

.

ICD-10 code description

.

5

Description of health condition studied

Delirium

ICD-10 code

T88.59

ICD-10 code description

Other complications of anesthesia

Primary outcomes

1

Description

Hemodynamic changes, including systolic blood pressure, diastolic blood pressure, mean arterial pressure, and heart rate, after surgery.

Timepoint

The night before surgery, before anesthesia induction, upon intensive care unit admission, and 6, 12, 24, 48, and 72 hours after surgery.

Method of measurement

Systolic, diastolic, and mean arterial pressure measured by invasive arterial monitoring, and heart rate recorded using electrocardiography.

2

Description

Changes in serum C-reactive protein levels as an inflammatory marker in patients undergoing open-heart surgery.

Timepoint

The night before surgery, before anesthesia induction, and at discharge from the cardiac intensive care unit.

Method of measurement

Measurement of serum C-reactive protein levels in venous blood samples using a validated laboratory method

3

Description

Changes in serum cortisol levels as a marker of the physiological response to surgical stress.

Timepoint

The night before surgery, before anesthesia induction, and at discharge from the cardiac intensive care unit.

Method of measurement

Measurement of serum cortisol levels in venous blood samples using a validated laboratory method.

4

Description

Changes in the neutrophil-to-lymphocyte ratio as an inflammatory marker in patients undergoing open-heart surgery.

Timepoint

The night before surgery, before anesthesia induction, and at discharge from the cardiac intensive care unit.

Method of measurement

Calculation of the neutrophil-to-lymphocyte ratio using the differential white blood cell count from venous blood samples.

5

Description

Changes in the level of sedation and agitation in patients after open-heart surgery.

Timepoint

Upon admission to the cardiac intensive care unit and 6, 12, 24, 48, and 72 hours after surgery.

Method of measurement

Assessment of sedation and agitation using the Richmond Agitation-Sedation Scale at the specified time points.

6

Description

Changes in sleep quality in patients after open-heart surgery.

Timepoint

On the mornings of postoperative days 1, 2, and 3, after the patient has fully regained consciousness.

Method of measurement

Assessment of sleep quality using the Richards-Campbell Sleep Questionnaire, based on the patient's responses to the questionnaire items at the specified time points.

7

Description

Incidence of postoperative delirium in patients admitted to the cardiac intensive care unit.

Timepoint

During the cardiac intensive care unit stay, up to 72 hours after surgery.

Method of measurement

Delirium is screened using the Intensive Care Delirium Screening Checklist by trained nurses blinded to group

allocation.

Secondary outcomes

empty

Intervention groups

1

Description

Intervention group:Inhalational aromatherapy with standardized lemon essential oil. Five drops of lemon essential oil are applied to sterile cotton and administered every two hours, beginning on the night before surgery and continuing until the patient is transferred to the operating room. The intervention is discontinued during general anesthesia and mechanical ventilation. After admission to the cardiac intensive care unit, five drops of lemon essential oil are placed in the oxygen flowmeter set at a flow rate of 4 liters per minute while the patient receives oxygen via nasal cannula. Following the return of spontaneous breathing and extubation, the intervention is resumed using the same method every two hours and continued until 24 hours after surgery.

Category

Prevention

2

Description

Control group: Inhalational aromatherapy with bitter almond oil as a placebo. Five drops of bitter almond oil are applied to sterile cotton and administered every two hours according to the same schedule as the intervention group, beginning on the night before surgery and continuing until the patient is transferred to the operating room. The intervention is discontinued during general anesthesia and mechanical ventilation. After admission to the cardiac intensive care unit, five drops of bitter almond oil are placed in the oxygen flowmeter set at a flow rate of 4 liters per minute while the patient receives oxygen via nasal cannula. Following the return of spontaneous breathing and extubation, the intervention is resumed every two hours and continued until 24 hours after surgery. All other study procedures are identical in both groups.

Category

Placebo

Recruitment centers

1

Recruitment center

Name of recruitment center
Shahid Modarres Hospital

Full name of responsible person
Siavash Sangi

Street address
Tehran – Yadegar-e Imam Highway – Sa'adat Abad Intersection

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2

Recruitment center

Name of recruitment center
Imam Hossein Hospital

Full name of responsible person
Siavash Sangi

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Sponsors / Funding sources

1

Sponsor

Name of organization / entity
Shahid Beheshti University of Medical Sciences

Full name of responsible person
Deputy Director of Research and Technology

Street address
Tehran - Shahid Chamran Highway - Yemen Street - Shahid A'arabi Street - Building No. 2 - 5th Floor

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Grant name

Grant code / Reference number

Is the source of funding the same sponsor organization/entity?
Yes

Title of funding source
Shahid Beheshti University of Medical Sciences

Proportion provided by this source
100
Public or private sector
Public
Domestic or foreign origin
Domestic
Category of foreign source of funding
empty
Country of origin
Type of organization providing the funding
Academic

Person responsible for general inquiries

Contact
Name of organization / entity
Shahid Beheshti University of Medical Sciences
Full name of responsible person
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Position
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Latest degree
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Sharing plan

Deidentified Individual Participant Data Set (IPD)
Yes - There is a plan to make this available
Study Protocol
No - There is not a plan to make this available
Statistical Analysis Plan
No - There is not a plan to make this available
Informed Consent Form
Yes - There is a plan to make this available
Clinical Study Report
Yes - There is a plan to make this available
Analytic Code
Undecided - It is not yet known if there will be a plan to make this available
Data Dictionary
Not applicable
Title and more details about the data/document
Only a part of the data, such as the information related to the main result or the like, can be shared.
When the data will become available and for how long
Access period 6 months after publication of results
To whom data/document is available
It will be available only to researchers working in academic and scientific institutions.
Under which criteria data/document could be used
No special conditions are considered.

From where data/document is obtainable

Siavash Sangi siavashsangi@gmail.com

What processes are involved for a request to access data/document

After receiving the applicant's email, the documents will be sent in a short period of time.

Comments