

Effect of aromatherapy on the pain of arteriovenous fistula puncture in patients on hemodialysis: a systematic review

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Abstract

Purpose – This study aims to determine the effect of aromatherapy used in reducing the pain caused by fistula puncture in hemodialysis patients.

Design/methodology/approach – In this study, the effect of aromatherapy application on fistula puncture was analyzed and carried out by scanning the relevant literature. The literature review was conducted between August and October 2020. While reviewing the literature, the authors used “aromatherapy,” “pain,” “fistula,” “puncture,” “hemodialysis” keywords and various combinations of these; moreover, Google scientist, Pubmed, Cochrane, ScienceDirect, Web of Science, Medline and Ovid databases and studies, which were conducted in the last 10 years were reviewed. As a result of the literature review, 1183 studies were reached and seven of them were included in the study by taking the inclusion criteria into account.

Findings – The randomized controlled studies are six studies and nonrandomized controlled experimental 1 study were added to the scope of the study and seven studies were included in the sample. In these studies, personal information forms developed by the researchers as data collection tools and the VAS scale, Numerical pain rating, the numeric rating scale were used to evaluate pain.

Practical implications – It has been determined that aromatherapy application in hemodialysis patients has positive effects on reducing pain due to puncture fistula intervention.

Originality/value – This study provides reduction or elimination of fistula needle insertion pain in hemodialysis patients.

Keywords Aromatherapy, Hemodialysis, Fistula, Puncture, Pain

Paper type Review

Introduction

End-stage renal failure (ESRF) is a serious health problem with a rapidly increasing prevalence worldwide, resulting in high rates of mortality [1]. In ESRF patients, the most frequent and preferred method to restore the disappearing kidney functions is hemodialysis treatment [2, 3]. For hemodialysis treatment to take place, the medical provider must establish a connection between the device and the patient by vascular access [4]. This method of vascular access in dialysis patients is known as an arteriovenous fistula (AVF). AVF is created as a result of a surgical procedure that connects an artery and a vein under the skin [5]. For patients to receive hemodialysis treatment, a needle must be inserted into the AVF each time. Considering that patients receive dialysis treatment at least three times a week, patients receive needle interventions quite frequently [6, 7].



Due to the fistular needle intervention, which is compulsory for conducting hemodialysis treatment, patients experience stress and anxiety. Patients often complain about the pain caused by the needle intervention [8, 9]. It is important to address the pain and concerns of patients with simple interventions and safe methods.

Pain management is one of the most basic nursing interventions. By controlling pain, patients may have increased satisfaction and improved quality of life [6]. Pain management may be achieved by nonpharmacological and pharmacological methods. Pharmacological treatments are considered as risky because they may induce addiction in the patient and cause side effects and complications [10]. On the other hand, nonpharmacological methods are recommended because they are inexpensive and cause fewer side effects and complications [1, 11]. Among nonpharmacological pain management precautions, recent studies have reported that practices such as distraction, skin stimulation methods, cold applications and aromatherapy may be used as effective and safe methods to alleviate pain [1, 12]. In aromatherapy, essential oils obtained from flowers and other plant parts are inhaled by patients or applied on patients' skin to reduce stress, anxiety and concerns in order to achieve pain management [9, 12].

Scientists report that the stimulating feature of essential oils used in aromatherapy is due to the fact that their chemical structures closely similar to hormones [13]. The penetration potential of these oils into the subcutaneous tissues is one of the important effects of this treatment. The mechanism of action of essential oils involves the integration of essential oils into the biological signaling of receptor cells in the nose during inhalation of the oil. The signal is transmitted to the limbic and hypothalamus regions of the brain through the olfactory bulb [14]. These signals cause the brain to release neurotransmitters such as serotonin, endorphins and so on. This process provides a sense of relaxation by connecting our nerve cells and other body systems. Serotonin, endorphins and noradrenaline are released from calming, euphoric and stimulating oils, to achieve the desired effects on the mind and body [15].

The effects of essential oils on the central nervous system (CNS) may vary according to the properties of the oil used. For example, rosemary is an herb rich in resin, tannic acid and an essential oil that causes CNS stimulation. Its active ingredients are bornyl acetate, borneol with other esters and special camphor similar to that found in myrtle, cineole, pinene and camphene [16]. Its stimulating property on the nervous system is beneficial in hysteria and paralysis [17].

Other examples are linalool and linalyl acetate, which are found in lavender. These compounds cause CNS depression and are readily absorbed into the skin during massage. Linalool exerts sedative effects. Linalyl acetate exhibits pronounced narcotic effects [13, 18].

In addition, there are many essential oils with antibacterial, antifungal, antiviral, anti-inflammatory, antitumor, antioxidant, spasmodic and hormonal effects [13]. Various types of essential oils can be used in the management of problems such as anxiety, agitation, stress, compulsive behaviors, fatigue, insomnia, burnout, memory loss and pain that patients complain about [19, 20]. The essential oils that are ideal for pain management include rosemary, eucalyptus, lavender, German chamomile, manuka, sweet marjoram, dwarf pine and ginger [13].

Nurses are the primary healthcare service providers for patients receiving hemodialysis treatment. Therefore, nurses usually place fistula needles on the patients' AVF. They also plan and implement the correct interventions for pain that emerges due to cannulation and assessing the effectiveness of the implemented method [6]. Our study aimed to determine the effects of aromatherapy on pain that occurred during fistula needle intervention in ESRF patients receiving hemodialysis treatment.

Essential oils are generally used safely with minimal side effects. The most common side effects are eye, mucous membrane and skin irritation and sensitivity, especially due to oils containing aldehydes and phenols. Allergic reactions have been reported in a few cases,

particularly with topical application. To our knowledge, there is no study showing that oils are harmful when used in aromatherapy. Recommendations for the safe use of essential oils in aromatherapy include: (1) diluting the essential oil to be used for aromatherapy massages at a rate of 3% or less, (2) using a lower concentration when used in individuals younger than 15 years of age, (3) avoiding essential oils completely during pregnancy, (4) performing a patch test to eliminate concerns before application, if there is uncertainty about a possible reaction. It is recommended to use a 1% concentration initially for the protocol. Essential oil vapors should not be inhaled directly by people with a diagnosis of asthma or those reporting airway hyperreactivity for odor. In this group, the use of a maximum of 1% concentration of essential oil is recommended for aromatherapy massage [21].

Although different applications exist for fistula needle intervention pain in ESRD patients, interventions related to aromatherapy are often not used in clinical practice due to concerns, difficulty in use, lack of knowledge and inexperience [22, 23]. This study aims to summarize the results of previous randomized controlled and quasi-experimental studies in patients receiving dialysis treatment [24]. Our study systematically reviewed articles to determine the effect of aromatherapy applied during fistula needle intervention on pain in ESRD patients receiving hemodialysis treatment. We also strive to ensure that nurses know more about aromatherapy and their effects in clinical practice with hemodialysis patients [25].

Methods

We conducted a systematic review guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Checklist reporting item for systematic reviews [26, 27].

Search strategy

We reviewed the relevant literature on the effects of aromatherapy application on needle intervention pain in articles published from 2010 to 2020. The literature review was conducted between August and October 2020. We used the keywords of “aromatherapy,” “pain,” “fistula,” “puncture” and “hemodialysis” and various combinations of these, to identify articles in the Google Scholar, PubMed, Cochrane, ScienceDirect, Web of Science, Medline and Ovid databases.

Inclusion and exclusion criteria

Our inclusion criteria specified that all studies in the English language published from 2010 to 2020, which investigated the effects of aromatherapy application on needle intervention pain in hemodialysis patients, were included in this systematic review. We excluded other systematic reviews, descriptive studies, case reports, letters to the editor, studies where a different method was applied to the experiment group in addition to aromatherapy, studies conducted on animals and other studies that were not suitable.

Study titles retrieved by the search were assessed for inclusion by one reviewer. A sample of excluded titles was checked by a second reviewer. Potentially relevant abstracts and full texts of articles were assessed by two reviewers. We resolved any discrepancies through discussion.

Data collection

We used the PRISMA statement to guide our systematic review. We used the EndNote X9 program to save copies of the articles and separate out duplicate articles. We had a consensus on the studies that were included in this study. There was no disagreement between the authors.

Study quality assessment

The quality of the studies included in the review was assessed by two different tools. To assess randomized controlled studies, the “Risk of Bias” checklist from the Cochrane Collaboration was utilized [28]. The bias of randomized controlled studies was assessed under seven categories (Table 1). For the quasi-experimental studies, the checklist from the Joanna Briggs Institute was used [29]. The checklist was assessed in nine steps (Table 2).

Ethical issue

This study used only publicly available, non-identifiable data and thus did not require human subjects review.

Results

After searching the aforementioned databases with the specified keywords, we identified 1183 studies. Due to duplication, 241 studies were removed from the review. In total, 922 other studies were eliminated after we examined their titles and abstracts for relevancy. Thirteen studies that did not fit the inclusion criteria were excluded. For our systematic review, we examined seven studies that evaluated the effects of aromatherapy application on needle intervention pain (Figure 1). Table 3 summarizes the characteristics of the studies included in the systematic review.

In their study examining the effects of sweet orange aromatherapy on pain and anxiety during needle placement in hemodialysis patients, Reyes *et al.* [9] dripped 3–4 drops of sweet orange oil on a piece of cotton before needle intervention for patients in the experimental group. Patients inhaled the sweet orange oil from a distance of 4–5 cm for 5 min. The control group had a breathing exercise for 3 min. Each patient received the treatment one time. The pain score in the experimental group decreased from 2.04 to 0.80 after aromatherapy, showing a strong effect. Lower pain levels were found in the patients receiving sweet orange aromatherapy compared to those that completed breathing exercises ($p < 0.001$).

Study	Was technique to reduce risk of bias applied?						
	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting	Other sources of bias
Thenmozhi and Pauline, 2020 [12]	+	+	?	?	?	+	–
Kilic Akca <i>et al.</i> , 2020 [30]	+	+	?	?	+	+	+
Tasan <i>et al.</i> , 2019 [31]	+	+	?	+	?	+	–
Ghods <i>et al.</i> , 2015 [8]	+	+	?	?	–	–	–
Bagheri-Nesami <i>et al.</i> , 2014 [33]	+	+	+	+	?	?	?

Table 1. The Cochrane collaboration’s tool for assessing risk of bias in the systematic review of effect of aromatherapy on arteriovenous fistula puncture on hemodialysis patients, 2010–2020

Note(s): (+) Yes, technique to reduce bias was successfully used. (?) Unclear if technique to reduce bias was used. (–) No, technique to reduce bias was not used

Study	1. Is it clear in the study what is the "cause" and what is the "effect?"	2. Were the participants included in any comparisons similar?	3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	4. Was there a control group?	5. Were there multiple measurements of the outcome both before and after the intervention/exposure?	6. Was the follow up complete, and if not, were differences between the groups in terms of their follow up adequately described and analyzed?	7. Were the outcomes of the participants included in any comparisons measured in the same way?	8. Were outcomes measured in a reliable way?	9. Was appropriate statistical analysis used?
Reyes <i>et al.</i> , 2020 [9]	Yes	Yes	Yes	Yes	Unclear	Yes	No	Yes	Yes
Aliasgharpour <i>et al.</i> , 2016 [32]	Yes	Yes	Yes	Yes	Unclear	Yes	No	Yes	Yes

Table 2.
Checklist for quasi-experimental studies in the systematic review of effect of aromatherapy on arteriovenous fistula puncture on hemodialysis patients, 2010–2020

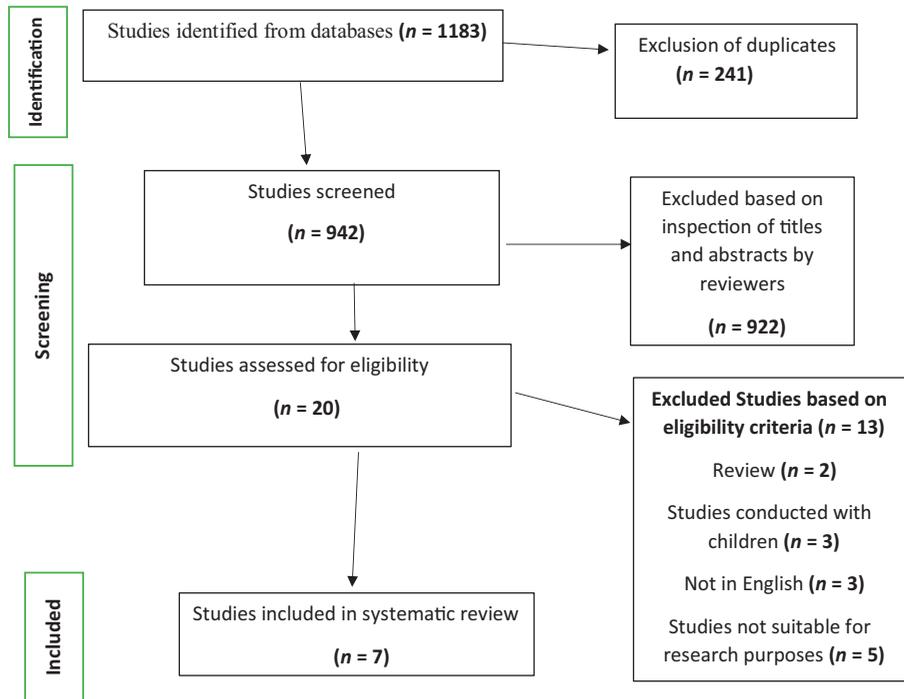


Figure 1. PRISMA flowchart of studies published from 2010 to 2020 included in systematic review of effect of aromatherapy on arteriovenous fistula puncture on hemodialysis patients

Thenmozhi and Pauline [12] applied lavender oil onto the skin in the AVF region for 5 min before the intervention. The control group received standard routine hospital care. The application was made in three consecutive hemodialysis sessions. The mean pretest and posttest mean pain scores in the experiment and control groups were as 2.31 and 4.34, respectively. The researchers concluded that the topical application of lavender oil was effective.

In their study of the effects of aromatherapy on pain and xerosis after repeated needle placement into the fistula arm in hemodialysis patients, Kilic Akca *et al.* [30] applied massage to the experiment group with lavender oil for a total of 12 sessions, which occurred three times a week and for 4 weeks. The second group received olive oil massage for the same duration. The third group received only standard care practices. Among the group receiving lavender oil, the pain score was 5.23 before the intervention. It was reduced to 2.43 after the intervention. The mean Visual Analog Scale (VAS) scores for the aromatherapy and olive oil massage groups for acute pain after intervention were found to be significantly lower than that of the control group ($p < 0.001$).

Tasan *et al.* [31] examined the effects of diluted lavender oil inhalation on pain development during vascular access in patients receiving hemodialysis treatment. Tasan *et al.* [31] dripped three drops of lavender oil onto a sterile sponge and placed the sponge at 10 cm from the nose of the patient. The patient inhaled the lavender oil for an average of 3–5 min in the experimental group. The control group received routine care. This implementation was carried out in three consecutive hemodialysis sessions. The mean pain score of the patients in the experimental group was 3.8 before lavender oil inhalation. The mean pain score decreased to 3.0 after lavender oil inhalation. This change was found to be statistically significant ($p < 0.05$).

No	Year	Author Name(s)	Type of study	Sample	Scale	Method of application	Results
1	2020	Reyes <i>et al.</i> [9]	Quasi-experimental study	Group 1: 25 Group 2: 25	The numeric rating scale (NRS)	Inhalation	Pain was significantly lower in the experimental group
2	2020	Thenmozhi and Pauline [12]	Randomized controlled experimental study	Group 1: 15 Group 2: 15	The numeric rating scale (NRS)	Topical	In the experimental group, the pain was significantly reduced as a result of topical application
3	2020	Kilic Akca <i>et al.</i> [30]	Randomized controlled experimental study	Group 1: 25 Group 2: 25 Group 3: 25	Visual analogue scale (VAS)	Topical	The mean VAS scores for post-intervention pain were significantly lower than the control group
4	2019	Tasan <i>et al.</i> [31]	Randomized controlled experimental study	Group 1: 30 Group 2: 30	Visual analogue scale (VAS)	Inhalation	Pain levels were significantly lower in the experimental group
5	2016	Aliasgharpour <i>et al.</i> [32]	Quasi-experimental study	Group 1: 20 Group 2: 20	Visual analogue scale (VAS)	Inhalation	Pain levels were significantly lower in the experimental group
6	2015	Ghods <i>et al.</i> [8]	Randomized controlled experimental study	Group 1: 17 Group 2: 17	The numeric rating scale (NRS)	Topical	Pain was significantly lower in the experimental group
7	2014	Bagheri-Nesami <i>et al.</i> [33]	Randomized controlled experimental study	Group 1: 46 Group 2: 46	Visual analogue scale (VAS)	Inhalation	The mean VAS scores for post-intervention pain were significantly lower than the control group

Table 3. Characteristics of the studies included in the systematic review of effect of aromatherapy on arteriovenous fistula puncture on hemodialysis patients, 2010–2020

Aliasgharpour *et al.* [32] dropped three drops of an aromatherapy mixture including lavender extract onto a piece of cotton. Patients in the experiment group inhaled lavender oil from a distance of 7–10 cm before placement of the needle. The control group received routine interventions. Pain severity was measured at every stage in three consecutive hemodialysis seasons after lavender aromatherapy application. The pain score of the control group increased from 5.36 to 5.58. However, the pain score of the experimental group decreased from 4.00 to 2.97, and the decrease was statistically significant.

Ghods *et al.* [8] sprayed lavender oil three times onto the AVF intervention region in the experiment group and waited for 5 min after each spray. In the placebo group, water was sprayed three times onto the AVF intervention region, and the researchers waited for 5 min after each spray. The control group did not receive any intervention. The intervention was applied for two consecutive times, and pain was assessed in an interval of 72 h. The pain

intensity was determined as 2.91 after topical lavender essential oil application, 4.18 after placebo application and 1.66 without any intervention. The difference in severity of pain among these three groups was significant ($p = 0.001$).

Bagheri-Nesami *et al.* [33] dripped three drops of lavender oil onto a piece of cotton. The cotton was placed at 10 cm from the nose of the patient. The patient breathed it for an average of 3–5 min in the experiment group. The control group received placebo aromatherapy for 5 min. These interventions were repeated in three consecutive hemodialysis sessions. Before the intervention, the mean VAS pain intensity scores in the experimental and control groups were 3.78 and 4.16 ($p = 0.35$). After three aromatherapy sessions, the mean VAS scores in the experiment and control groups were 2.36 and 3.43, and the difference was statistically significant ($p = 0.009$).

Discussion

In hemodialysis patients, pain is a disturbing experience that is experienced during insertion of the fistula needle in every dialysis session. It is highly important to achieve pain management for patients receiving hemodialysis treatment. Holistic nursing interventions are frequently used in pain management [34–36]. Lakhan *et al.* [37] reported that aromatherapy was more effective in reducing pain in comparison to control and placebo groups. In all studies included in our study, it was determined that aromatherapy reduced the pain levels of fistula needle interventions in hemodialysis patients.

By triggering mechanisms in the brain by stimulating the olfactory system with essential oils, aromatherapy blocks the pain nerve messages of the sodium flow in nerve fibers transmitting pain by blocking the sodium channels [38]. It also stimulates the receptors in the olfactory bulb, transmits the message to the limbic system and causes secretion of endorphin, enkephalin and serotonin. With the secretion of these hormones, there is relaxation in the individual, which causes pain and stress to decrease [12]. In our review, researchers used the inhalation method ($n = 4$) and topical application method ($n = 3$) (Table 3).

Reyes *et al.* [9], Tasan *et al.* [31], Aliasgharpour *et al.* [32] and Bagheri-Nesami *et al.* [33] used the inhalation method for aromatherapy application in their studies. While Reyes *et al.* [9] used sweet orange extract oil in aromatherapy, Tasan *et al.* [31], Aliasgharpour *et al.* [32] and Bagheri-Nesami *et al.* [33] used lavender oil. In the inhalation method, the lavender oil was used by dilution with sweet almond oil at a ratio of 1:10. Lavender oil is frequently preferred to relieve pain and stress, support immunity and eliminate skin problems [39].

While inhalation aromatherapy provides smell stimulation only, topical aromatherapy application achieves both smell stimulation and touch stimulation [40, 41]. The topical application of aromatherapy reduces pain by preventing painful stimuli from reaching the CNS. This is achieved by stimulating receptors with secretion of endogenous substances such as endorphin [42]. In the topical application of aromatherapy, lavender oil is preferred as the safest method [43]. Ghods *et al.* [8], Thenmozhi and Pauline [12], Kilic Akca *et al.* [30] applied lavender oil topically onto the skin in the AVF region. It was determined that pain significantly decreased as a result of this application.

Most of the studies in this systematic review used lavender oil for pain relief. The reasons for choosing lavender oil include that it is easily available, popular, has a good smell and has a known mechanism of action [44–46].

Conclusion

We observed different practices with different aromatherapeutic oils. Nevertheless, researchers reported that pain decreased for each of these different practices. Thus, we conclude that application of aromatherapy during the fistula needle intervention in

hemodialysis patients reduces pain. Studies have used different oils and different application methods (topical, inhalation, etc.). Therefore, nurses may select the practices that they will apply on patients based on the patient's status. In the future, we recommend that researchers conduct meta-analyses and subgroup analysis to obtain more accurate results on this topic.

As a result of our literature review, we determined that aromatherapy application in hemodialysis patients provided positive effects on reducing pain during fistula needle intervention. As aromatherapy application is an easy and relatively harmless practice, this method may be used as a practical method in pain management in nursing. However, we recommend that more studies are conducted to confirm these claims.

Conflict of Interest: None

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