

Cryotherapy Versus Lavender Oil Inhalation on Alleviating Arteriovenous Fistula Puncture Pain among Patients with Hemodialysis

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Abstract

The management of pain associated with arteriovenous fistula (AVF) puncture is crucial in nursing care and is regarded as one of the most challenging situations that nurses and patients undergoing hemodialysis (HD) face. **Aim:** evaluate the effect of cryotherapy versus lavender oil inhalation on alleviating arteriovenous fistula puncture pain among Hemodialysis Patients. This study applied **Quasi-experimental research design**. **Setting:** The study was carried out in Egypt's Menoufia University Hospital's dialysis unit. **Subjects:** The study involved a purposive sample of 60 patients receiving hemodialysis with AVF in the aforementioned setting. **Three tools** were utilized to gather the data; tool I: a structured interview questionnaire, tool II: Visual analogue Scale (VAS), and tool III: Physiological parameters assessment sheet. **Results** revealed that patients in the two groups (Cryotherapy and Lavender oil inhalation) experienced lower pain during AVF puncture in post application and follow up compared to preapplication. Additionally, patients in the cryotherapy group experienced lower degree of pain during AVF puncture than patients in the lavender oil inhalation group in post application and follow up of both, as the mean score of pain VAS was 2.63 during AVF puncture before application of cryotherapy in the 1st visit and became 1.56 and 1.16 after application of cryotherapy in the 2nd and 3rd visit, respectively. However, the mean score of pain VAS was 2.46 during AVF puncture before inhalation of lavender oil in the 1st visit and became 1.83, 1.8 after inhalation of lavender oil in the 2nd and 3rd visit, respectively. **Conclusion:** both cryotherapy and lavender oil inhalation positively affected AVF puncture pain among HD patients, but cryotherapy was more effective than lavender oil inhalation on alleviating AVF puncture pain. **Recommendations:** The application of cryotherapy for HD patients should be considered part of the routine care in HD units for alleviating AVF puncture pain.

Keywords: Arteriovenous fistula, Cryotherapy, Hemodialysis, Lavender oil inhalation, Pain

Introduction

Hemodialysis (HD) is the most frequently given kidney replacement therapy for patients suffering from chronic kidney disease. During hemodialysis, wastes and extra fluids are removed from the blood using a dialyzer (a filtering device), which then pumps the clean blood back into the body (*Tandukar & Palevsky, 2019*). For hemodialysis, the best and most effective vascular access type is the arteriovenous fistula (AVF). For the majority of patients requiring hemodialysis, it is the recommended access, and often done in the lower portion of the nondominant arm but can be done in the upper arm as well (*Harwood, Wilson & Goodman, 2017*). During hemodialysis, two needles

are inserted into the arteriovenous fistula to allow blood flow out of the body to the machine through one needle and the other needle allows blood flow back into the arteriovenous fistula (*Ball, 2017*).

A large-caliber needle is needed for hemodialysis to be effective in order to ensure that the arteriovenous fistula is flowing. The AVF fistula puncture is done repetitively, generally 3 times a week and can be a painful experience for some patients. Arteriovenous fistula puncture-related pain prevalence is often variable (between 40% and 60%) and rarely investigated (*Brkovic, Burilovic, and Puljak, 2016*).

The International Association for the Study of Pain (2020) defines pain as "An unpleasant sensory and emotional experience associated with, or approximating that associated with, actual or potential tissue injury". In the routine practice of hemodialysis, pain on AVF cannulation is a chronic issue. Depending on the criteria and the techniques used to measure pain, its prevalence can range from 12 to nearly 80 percent, and it affects hemodialysis patients' quality of life (*Kosmadakis, Amara & Costel, 2021*). Patients' quality of life and contentment may improve when their pain is under control. Nurses are responsible for anticipating cannulation pain and planning the best strategies to lessen it (*Alzaatreh and Abdalrahim, 2020*).

For the management of AVF puncture pain, both nonpharmacological and pharmaceutical methods are available. The use of pharmaceutical treatments is seen to be harmful because patients may become addicted to them, which could lead to side effects and complications. Nonpharmacological methods are advised instead because they result in fewer side effects and consequences (*Al Hasbi, Chayati, and Makiyah, 2019*). Non-pharmacological pain management techniques, such as cryotherapy, which involves applying ice packs or bags topically to reduce pain in specific areas (*Garcia, Karri, Zacharias, and Abd-Elsayed, 2021*).

Cryotherapy, often known as cold analgesia, is the therapeutic application of any material of extremely low temperature that releases heat from the body. The cold causes vasoconstriction, which reduces tissue blood flow, metabolism, oxygen uptake, inflammation, and muscle spasm. Topical cold therapy lowers the temperature of the skin and underlying tissues to a depth of 2-4 cm, which lowers the threshold for activating tissue nociceptors and the speed at which pain nerve signals are transmitted. These have an effect known as cold-induced neuropraxia, which is a local anesthetic (*Chilakamuri, Svsq, & Nuvvula, 2020*). Cryotherapy is a straightforward, low-risk method that appears to be successful in easing the pain brought on by AVF puncture. Cryotherapy has been shown to be effective in reducing pain associated with arteriovenous fistula puncture in hemodialysis patients, according to analysis of numerous studies (*jafari-koulaee, Moosazadeh, Nesami, and Goudarzian, 2020*).

Another non-pharmacological approach of pain management is aromatherapy, which uses concentrated essential oils derived from herbs,

flowers, and other plant components. Advocates of aromatherapy assert that herbal medicine has a long history and has been used for thousands of years in places like Egypt and India (*Farrar & Farrar, 2020*). Inhaled aromatherapy has been found in numerous trials to increase sleep quality and overall well-being while reducing stress, anxiety, sadness, and pain from arteriovenous fistula punctures. Lavender essential oil, sweet orange oil, rosemary, rose, and other fragrant essential oils have all been examined (*Bouya, Ahmadidarehsima, Badakhsh, Balouchi, & Koochakzai, 2018; Yang, Chen, & Meng, 2020*).

Lavender oil is one of the essential oils with a significant role in aromatherapy. There is a long history of using lavender as medicine. Linalool and linalyl acetate, which are present in lavender, have been shown in studies on the advantages of lavender fragrance to stimulate the parasympathetic nervous system. Linalool also has sedative properties, and linalyl acetate is a narcotic (*Aliasgharpour, Abbaszadeh, Mohammadi & Kazemnejad, 2016*). So, in many medical and surgical procedures associated with pain, lavender oil could be used as a safe, straightforward, and affordable nursing care strategy. It has been demonstrated to be useful in reducing pain in HD patients during AVF puncture (*Şahin, Tokgöz, and Demir, 2021*).

Significance of the study

Each year, the number of patients diagnosed with HD continues to increase. Additionally, more patients need continuous renal replacement therapy (*Andrzej, Agata, Natalia, Kamila, & Sieron, 2017*). Pain associated with AVF puncture affects patients receiving continuous hemodialysis about 300 times a year (*jafari-koulaee, Moosazadeh, Nesami, and Goudarzian, 2020*). For patients on maintenance HD, pain from an AVF puncture is the most common problem. Unrelieved persistent pain may adversely affect a patient's quality of life, functional abilities, and general health. As a result, in the context of dialysis care, pain management during AVF needling ought to take precedence (*Alzaatreh & Abdalrahim, 2020*). Non-pharmacological management should come first in the proposed hierarchy of management, followed by medications if necessary. Numerous non-pharmacological techniques, such as biofeedback, cryotherapy, Aromatherapy, music therapy, laughing therapy, touch therapy, and others, can reduce the sense of pain (*Sharma & Kaur, 2020*). Therefore, the current study aimed to evaluate the effect of cryotherapy versus lavender oil Inhalation on alleviating

arteriovenous fistula puncture pain among hemodialysis patients.

Aim of the study

The study's aim was to evaluate the effect of cryotherapy Versus Lavender Oil Inhalation on Alleviating Arteriovenous Fistula Puncture Pain among Hemodialysis Patients.

Research hypothesis:

- The application of cryotherapy and lavender oil inhalation are expected to alleviate arteriovenous fistula puncture pain among hemodialysis Patients.
- The application of cryotherapy is expected to alleviate arteriovenous fistula puncture pain than lavender oil inhalation among hemodialysis patients.

Operational definitions:

- **Arteriovenous fistula puncture related pain** is a an unpleasant, sensory, and emotional experience brought on by the puncture of an arteriovenous fistula, as measured by the Standardized Numerical Pain Assessment Scale.
- **Cryotherapy:** Interrupted periods of slow circular motion massage with (2–3) cm of frozen, purified water inside a plastic bag over the arteriovenous fistula puncture site until the patient feels numbness prior to needle puncture.
- **Lavender oil inhalation:** inhalation of 100% pure organic lavender oil into a cotton ball containing two drops at five centimeters distance from nose by a slowly breathing while keeping eyes closed for 15 minutes before needle puncture.

Subjects and Method

In this study, a quasi-experimental research design was employed. The study was carried out at the Menoufia University Hospital's Dialysis unit, which is located on the third floor. The dialysis unit includes three wide rooms with a total number of 16 occupied beds with a curtain around each bed to ensure patients' privacy.

Subjects

A purposive sample of 60 patients in the aforementioned setting who are undergoing hemodialysis through an arteriovenous fistula and fulfill the following (inclusion criteria); Adult (20-60 years old), male and female patients, subjecting to needle puncture without using any measures to lessen the pain during puncture, having healthy arteriovenous fistula skin without signs of inflammation or infection, capable of giving adequate response to pain, not suffering from chronic sinusitis, a lavender allergy, or any other

problems, such as a broken nose or a nose operation that interfered with one's sense of smell, available at the time of data collection, as well as willing to participate in the study and to grant their consent. Patients with sensitivity or contraindication to cold application, peripheral vascular diseases, diabetic neuropathy, mental illness, altered level of consciousness, and suffering from pain of other origin than arteriovenous fistula were excluded to avoid affecting the result.

Patients were allocated evenly into Group I, which received cryotherapy, and Group II, which received lavender oil, using a simple random sampling technique.

Tools of data collection:

To gather the required data, three tools were used:

Tool I: Structured Interview Questionnaire:

After reviewing relevant recent literature, (*Nasirzadeh, Mircheraghi, Ghodrati & Shareinia (2019), Shehab (2019) and Elhalafawy, Bahgat, Abd-Elhafez & Farag (2020)*). The researchers developed this two-part tool, which is as follows:

Part 1. Demographic data of patients that include, age, sex, marital status, level of education, occupation, and living condition.

Part 2. Medical data such as, duration of chronic kidney disease, used arteriovenous fistula site and duration, duration of hemodialysis session, and number of hemodialysis session per week.

The validity of this tool was checked by a jury of seven urology and medical surgical nursing specialists who evaluated the questionnaire's clarity, relevance, understandability, and suitability for implementation. The appropriate adjustments were made in accordance with that. Additionally, its reliability was tested by looking at how consistently the tool's score changes with use through Spearman's correlation coefficient, which was 0.89, guaranteed the reliability.

Tool II: Visual analogue Scale (VAS):

This tool is one of the most often used self-report measures for measuring patients' subjective pain in clinical settings. It is adopted from *Katz and Melzack (1999)*. It consists of 10 cm straight horizontal line with two extreme endpoints; the first (0) which indicates no pain at all and the last (10) which indicates the worst imaginable pain. Patients were asked to point their pain level in the distance

between the two endpoints. The validity and reliability of VAS has been evaluated in many studies. Most of the studies showed that visual analogue scale is a valid and reliable scale for pain measurement (*Begum, 2019*).

Scoring system:

The score for each level of pain will be determined as follows: 0 for no pain, 1-3 for mild pain, 4-6 for moderate pain, 7-9 for severe pain, and 10 for the worst pain possible.

Tool III: Physiological parameters assessment sheet:

This tool will be developed by the researchers after reviewing the related recent literature (*Nasirzadeh, Mircheraghi, Ghodrati & Shareinia (2019), Shehab (2019) and Elhalafawy, Bahgat, Abd-Elhafez & Farag (2020)*). It comprises evaluation of physiological parameters like heart rate, respiratory rate, and blood pressure that might be affected by painful feelings. It was measured both before and after applying cryotherapy and inhaling lavender oil.

Method

- Before beginning this study, The Faculty of Nursing, Menoufia University requested permission to conduct the study through a written approval from the director of the Menoufia University hospital and the head nurse of dialysis unit.
- Responsible authorities of the hospital and dialysis unit were informed about the study's objectives, the time and date that data collection would begin.
- Data collected through three phases: the preparatory phase, the implementation phase and Evaluation phase.
- **Preparatory phase:** the researchers developed the first and third tools after conducting a thorough literature review. Tool II (Visual Analogue Scale) was adopted.
- To assess the clarity, feasibility, accuracy, and applicability of the research tools, a pilot study was conducted utilizing the previously mentioned tools on 10% (6 patients) of the study subjects in the aforementioned setting. Patients who participated in the pilot trial were included in the study sample because there were no modifications made following the pilot study.
- **Implementation phase:** during this phase, the researchers attended two dialysis sessions each day from Saturday through Thursday (three visits for each patient) to collect the data.
- Patients who met the inclusion criteria from the aforementioned setting were recruited. The researchers then introduced themselves to each patient and obtained their informed consent after explaining the aim and maneuver of the study. The confidentiality and privacy of every patient were ensured. The patient has the right to discontinue their involvement in the research at any time.
- Initial assessment was carried out to collect demographic and medical data from the study subjects using tool I. The researchers then gave each patient a brief explanation of the Visual Analog Scale and how to apply it.
- The researchers performed a sensitivity test to cold on the collateral site to the arteriovenous fistula.
- The first visit (pretest) for each group was conducted without intervention, and the researchers recorded the physiological parameters for each patient prior to and following an AVF puncture using tool III. Additionally, pain was assessed for each patient using tool II.
- During the second visit (posttest), cryotherapy and lavender oil inhalation were used as interventions for the specified group. the researchers used tool III to record each patient's physiological parameters both before and after an AVF puncture. Each patient's level of pain was also evaluated using tool II.
- For the cryotherapy group (Group I), the researchers tested each patient's susceptibility to cold on the collateral site of the arteriovenous fistula. A plastic bag containing two to three centimeters of frozen distilled water was placed over the arteriovenous fistula puncture site with slow interrupted circular motion massage to avoid skin injury until the patient felt numbness before the needle was inserted. When necessary, the melting ice was replaced.
- Each patient received a special ice bag that was marked with their name in order to prevent cross-infection. The ice bags were also cleaned with soap and water after each usage and put in a fresh bag in the refrigerator to prevent contamination.
- For the lavender oil group (Group II), two drops of 100% pure organic lavender oil were applied to a cotton ball, which was then inhaled by each patient at a distance of five centimeters from their nose while slowly breathing and keeping their

eyes closed for fifteen minutes prior to needle puncture.

- **Evaluation phase:** the researchers visit each patient in each group for the third visit. They used the same interventions as on the second visit, including cryotherapy and lavender oil inhalation. and record each patient's physiological parameters both before and after an AVF puncture using tool III. Additionally, each patient's level of pain was also evaluated using tool II.
- Comparison between both groups was done.
- Data was gathered by researchers over a three-month period, from the start of March 2021 to the end of May 2021.

Ethical considerations

The Research Ethics Committee, Faculty of Nursing, Menoufia University, Egypt, gave its approval to the study before it began (Research N. 846). Following explanation of the study's objectives and reassurance that the data collected would only be utilized for the study, the studied patients' verbal and written consents were acquired. Data collection was done with respect for the study participants' privacy and confidentiality, and only used for research purposes. Furthermore, the researchers stressed that participation is entirely optional, and that the confidentiality of the participants was ensured by coding all data and storing all papers in a locked cabinet. Also, all participants were informed that their reluctance to participate in the study would have no impact on their care.

Statistical analysis:

Statistical Package of Social Science (SPSS) version 20 (SPSS, Inc., Chicago, Illinois, USA) was used on an IBM personal computer for data collection, tabulation, and statistical analysis, where the following statistics were applied:

- **Descriptive statistics:** in which quantitative data were presented in the form of mean, standard deviation (SD), range, and qualitative data were presented in the form numbers and percentages.
- **Analytical statistics:** used to find out the possible association between studied factors and the targeted disease. The used tests of significance included:

The Chi square test is a test of significance used for comparison between two groups having qualitative variables.

t- test is a test of significance used for comparison between two groups normally distributed having quantitative variables.

Paired t test is a test of significance used for comparison between two related groups normally distributed having quantitative variables.

ANOVA (F) test is a test of significance used for comparison between three or more groups normally distributed having quantitative variables.

Pearson's correlation (r): is a test of significance used for correlating two quantitative variables.

P value of >0.05 was considered statistically non-significant.

P value of <0.05 was considered statistically significant.

P value of <0.001 was considered statistically highly significant

Results

Table (1) shows the difference of demographic characteristics between the studied groups. There was no statistically significant difference between the two groups (Cryotherapy & lavender oil) regarding their age, gender, marital status, occupation, educational levels, and their living condition. About half of both studied groups (Cryotherapy & lavender oil) (53.3%, 50 %) aged more than or equal to 50 years old. Nearly two thirds (63.3%, 73.3 %) of studied groups (Cryotherapy & lavender oil) were males and (76.7% & 70%) were married respectively. Most of them (53.3%, 40 %) had an intermediate education. (60% & 73.3%) of both groups respectively weren't employed and (93.3% & 96.7%) of them live with others.

Figure (1) shows the percentage distribution of the studied groups according to duration of their Chronic Kidney disease. One third of both groups (33.3%) of cryotherapy group were hemodialyzed from 1 to less than 3 years and (36.7%) of lavender oil group from 3 to less than 8 years.

Table (2) shows the difference between the studied groups according to their medical data. There was no statistically significant difference between both groups regarding all their medical data. Nearly one third of both groups (30%) made HD from their fistula from 1- less than 3 years and more than one third of lavender oil group (36.7%) from 3- less than 8 years. About three quarters of the studied groups (Cryotherapy & lavender oil

inhalation) (70%, 76.7 %) respectively had left arm fistula. The majority of them (86.7%, 83.3 %) respectively had three times HD per week and (96.7% & 86.7) had four-hour HD session. 86.7% of the cryotherapy group and 76.7 % of lavender oil group had comorbidities and the majority of them (92.3%, 91.4%) had diabetes mellitus and hypertension.

Table (3) presents the percentage distribution of pain level among both studied groups throughout the study periods before application of cryotherapy versus lavender oil inhalation (1st visit), after application of cryotherapy versus lavender oil inhalation (2nd visit) and follow up (3rd visit). As evident from the table, there was no statistically significant difference between both groups regarding their pain level before application of cryotherapy versus lavender oil inhalation ($p = .062$). However, there was a statistically significant difference between both groups regarding their pain level in the 2nd visit after application of cryotherapy versus lavender oil inhalation ($p = .037$) and a highly statistically significant difference of their pain level in the 3rd visit ($p = .001$).

Figure (2) states the mean scores of both groups according to their pain rating score before application of cryotherapy versus lavender oil inhalation (1st visit), after application (2nd visit), and in follow up (3rd visit). It was observed that both groups mean scores of pain were reduced in after application of cryotherapy versus lavender oil inhalation and in follow-up compared to before application of cryotherapy versus lavender oil inhalation, however the cryotherapy group's mean score of pain is less than the lavender oil inhalation group after application of cryotherapy versus lavender oil inhalation and in the follow up.

Table (4) shows the percentage distribution of physiological parameters of the cryotherapy group before and after AVF puncture. As evident from the table, there was a highly statistically significant difference between the 1st visit (without application of cryotherapy), 2nd visit, and 3rd visit (after application of cryotherapy) to all physiological parameters ($p = .001$).

Table (5) demonstrates the percentage distribution of physiological parameters of the lavender oil group before and after AVF puncture. There was a statistically significant difference between the 1st visit (without lavender oil inhalation), 2nd visit, and 3rd visit (after lavender oil inhalation) to (heart rate & respiratory rate) ($p = .050$ & $p = .036$).

Table (6) describes correlation between physiological parameters and level of pain before application of cryotherapy versus lavender oil inhalation (1st visit), after application of cryotherapy versus lavender oil inhalation (2nd visit), and in follow up (3rd visit). There was a statistically significant negative correlation between the level of pain of cryotherapy group and blood pressure of 3rd visit that means when pain level increased, blood pressure decreased. There was statistically significant positive correlation between the level of pain cryotherapy group and heart rate of 1st visit and 2nd visit that mean when pain level increased, heart rate increased. There wasn't statistically significant correlation between the level of pain of cryotherapy group and respiratory rate before and after intervention. Also, there wasn't statistically significant correlation between the level of pain of lavender oil inhalation group and all physiological parameters before and after intervention.

Table (1): The differences of demographic characteristics between the studied groups (n=60):

| Demographic data | Cryotherapy group (n=30) | | Lavender oil group (n=30) | | X2 | P value | |
|---|--------------------------|-------------|---------------------------|------------|----------------|---------|--|
| | N. | % | N. | % | | | |
| Age | | | | | | | |
| - Less than 20 | 2 | 6.7 | 2 | 6.7 | t-test .490 | .453 | |
| - 20 to 30 | 2 | 6.7 | 5 | 16.7 | | | |
| - 31 to 40 | 4 | 13.3 | 2 | 6.7 | | | |
| - 41 to less than 50 | 6 | 20.0 | 6 | 20.0 | | | |
| - More than or equal to 50 | 16 | 53.3 | 15 | 50.0 | | | |
| Mean age +SD | | 46.93±14.04 | | Median age | 52.0 | | |
| | | | | Range | 50.0 | | |
| Sex | | | | | | | |
| - Male | 19 | 63.3 | 22 | 73.3 | .405 | .580 | |
| - Female | 11 | 36.7 | 8 | 26.7 | | | |
| Marital status | | | | | | | |
| - Single | 4 | 13.3 | 8 | 26.7 | 5.424 | .482 | |
| - married | 23 | 76.7 | 21 | 70.0 | | | |
| - divorced | 0 | 0 | 1 | 3.3 | | | |
| - widow | 3 | 10.0 | 0 | 0 | | | |
| Educational levels | | | | | | | |
| - Illiterate | 7 | 23.3 | 7 | 23.3 | 1.460 | .169 | |
| - intermediate | 16 | 53.3 | 12 | 40.0 | | | |
| - high | 7 | 23.3 | 11 | 36.7 | | | |
| Occupation | | | | | | | |
| - Employee | 12 | 40.0 | 8 | 26.7 | .273 | .412 | |
| - non-employee | 18 | 60.0 | 22 | 73.3 | | | |
| If answer is (Employee). What type of work? | | | | | | | |
| - Need physical effort. | 7 | 23.3 | 3 | 10.0 | | | |
| - Not Need physical effort. | 5 | 16.7 | 5 | 16.7 | | | |
| Living condition | | | | | | | |
| - Alone | 2 | 6.7 | 1 | 3.3 | .554 | 1.000 | |
| - with others | 28 | 93.3 | 29 | 96.7 | | | |

*Significant at P value <0.05

** High significant at P value <0.001

X2: Chi Square

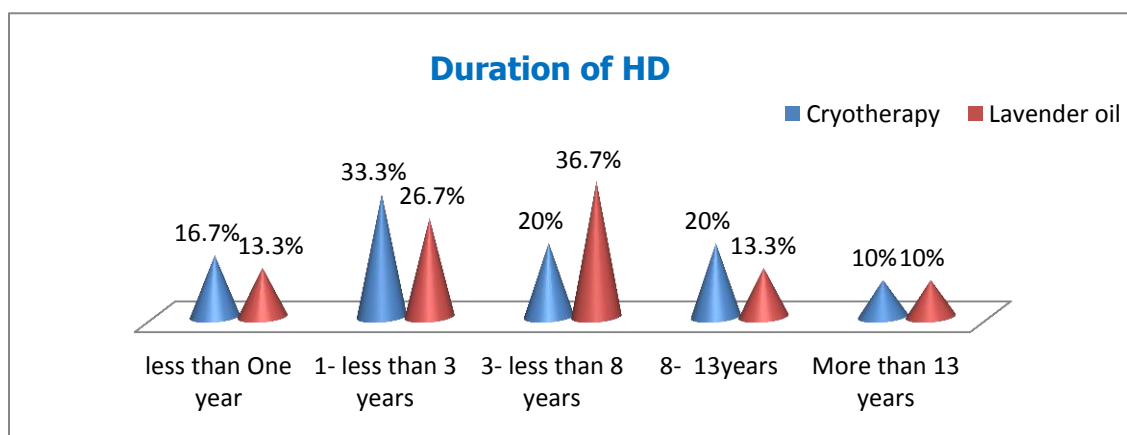


Figure (1): Percentage distribution of duration of Chronic Kidney disease between the studied groups (n=60):

Table (2): The differences of medical data between both studied groups (n=60):

| Medical data | Cryotherapy n=30 | | Lavender oil n=30 | | X2 | P value |
|--|---------------------|------|----------------------|------|--------------------------|-------------|
| | N. | % | N. | % | | |
| Fistula site | | | | | | |
| - Right arm | 5 | 16.7 | 6 | 20.0 | .133 | .792 |
| - Left arm | 21 | 70.0 | 23 | 76.7 | | |
| - CVC or peritoneal catheter | 4 | 13.3 | 1 | 3.3 | | |
| Duration of HD from worked Fistula | | | | | | |
| - less than one year | 9 | 30.0 | 3 | 10.0 | t-test -1.139 | .238 |
| - 1- less than 3 years | 9 | 30.0 | 9 | 30.0 | | |
| - 3-less than 8 years | 5 | 16.7 | 11 | 36.7 | | |
| - 8- 13 years | 4 | 13.3 | 4 | 13.3 | | |
| - More than 13 years | 3 | 10.0 | 3 | 10.0 | | |
| Mean +SD 4.94+4.52 Median 3.50 Range 16.00 | | | | | | |
| Frequency of HD per week | | | | | | |
| - Once | 0 | 0 | 0 | 0 | t-test 1.041 | .219 |
| - Twice | 3 | 10.0 | 5 | 16.7 | | |
| - Three times | 26 | 86.7 | 25 | 83.3 | | |
| - Daily | 1 | 3.3 | 0 | 0 | | |
| Number of hours per each HD session | | | | | | |
| - One | 1 | 3.3 | 0 | 0 | t-test .282 | .718 |
| - Two | 0 | 0 | 0 | 0 | | |
| - Three | 0 | 0 | 4 | 13.3 | | |
| - Four | 29 | 96.7 | 26 | 86.7 | | |
| Presence of other comorbidities | | | | | | |
| - Yes | 26 | 86.7 | 23 | 76.7 | .317 | .506 |
| - No | 4 | 13.3 | 7 | 23.3 | | |
| What are the other comorbidities? | | | | | | |
| - Diabetes mellitus and Hypertensions | 24 | 92.3 | 21 | 91.4 | .120 | .498 |
| - Hypertension and Heart disease | 2 | 6.7 | 1 | 4.3 | | |
| - Cancer | 0 | 0 | 1 | 4.3 | | |

*Significant at P value <0.05

** High significant at P value <0.001

X2: Chi Square

Table (3): Percentage distribution of pain level among both groups throughout the study periods before (1st visit), after application of cryotherapy Versus Lavender Oil Inhalation (2nd visit, and in follow up (3rd visit) (n=60):

| Pain Scoring | Cryotherapy n=30 | | | | | | Lavender oil n=30 | | | | | | F | P value |
|---------------------|---------------------|------|-----------|------|-----------|------|----------------------|------|-----------|------|-----------|------|-------------|---|
| | 1st visit | | 2nd visit | | 3rd visit | | 1st visit | | 2nd visit | | 3rd visit | | | |
| | N. | % | N. | % | N. | % | N. | % | N. | % | N. | % | | |
| 1-3 (mild) | 0 | 0 | 0 | 0 | 25 | 83.3 | 1 | 3.3 | 6 | 20.0 | 6 | 20.0 | 1.31 | P1: .257 P2: .037* P3:.001** |
| 4-6 (moderate) | 11 | 36.7 | 13 | 43.3 | 5 | 16.7 | 15 | 50.0 | 23 | 76.7 | 24 | 80.0 | | |
| 7-9 (Sever) | 19 | 63.3 | 17 | 56.7 | 0 | 0 | 13 | 43.3 | 1 | 3.3 | 0 | 0 | | |
| 10 (worst possible) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3.3 | 0 | 0 | 0 | 0 | | |

*Significant at P value <0.05

** High significant at P value <0.001

F: ANOVA test

P1: difference between the two groups before application of cryotherapy versus lavender oil inhalation (1st visit)P2: difference between the two groups after application of cryotherapy versus lavender oil inhalation (2nd visit)P3: difference between the two groups after application of cryotherapy versus lavender oil inhalation (3rd visit)

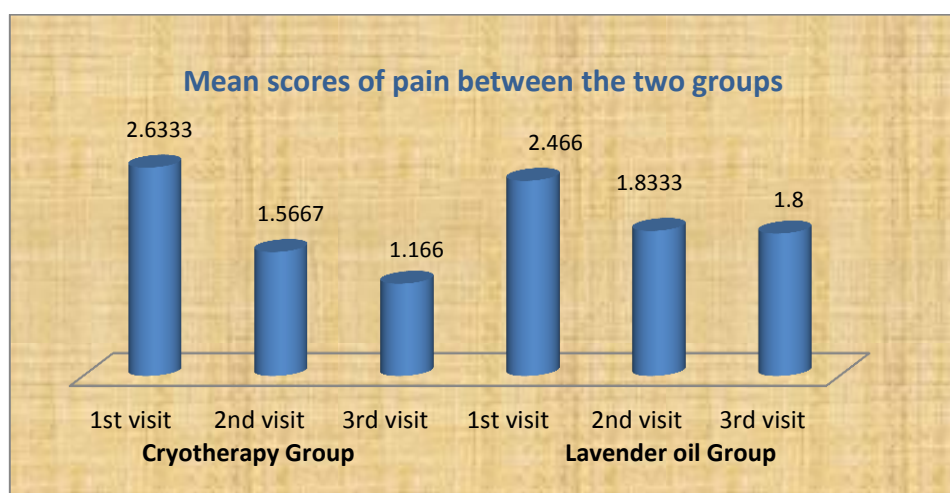


Figure (2): mean scores of both groups according to their pain rating score before application of cryotherapy and lavender oil inhalation (1st visit), after application (2nd visit), and in follow up (3rd visit) (n=60)

Table (4): Percentage distribution of physiological parameters of the cryotherapy group before and after AVF puncture (n=30):

| Physiological parameters | Cryotherapy Group n=30 | | | | | | | | | | | | F | P value |
|--------------------------|---------------------------------|------|--------------------|------|------------------------------|------|--------------------|------|------------------------------|------|--------------------|------|-------|---------|
| | 1st visit (without cryotherapy) | | | | 2nd visit (with cryotherapy) | | | | 3rd visit (with cryotherapy) | | | | | |
| | Pre- AVF puncture | | Post- AVF puncture | | Pre- AVF puncture | | Post- AVF puncture | | Pre- AVF puncture | | Post- AVF puncture | | | |
| | N. | % | N. | % | N. | % | N. | % | N. | % | N. | % | | |
| Heart rate | | | | | | | | | | | | | | |
| • 62-75 | 3 | 10.0 | 13 | 43.3 | 4 | 13.3 | 12 | 40.0 | 5 | 16.7 | 18 | 60.0 | 5.835 | .001** |
| • 76- 85 | 24 | 80.0 | 17 | 56.7 | 24 | 80.0 | 17 | 56.7 | 23 | 76.7 | 12 | 40.0 | | |
| • 86- 100 | 3 | 10.0 | 0 | 0 | 2 | 6.7 | 1 | 3.3 | 2 | 6.7 | 0 | 0 | | |
| Respiratory Rate | | | | | | | | | | | | | | |
| • 12-17 | 0 | 0 | 12 | 40.0 | 0 | 0 | 20 | 66.7 | 0 | 0 | 12 | 40.0 | 4.014 | .001** |
| • 18-22 | 26 | 86.7 | 18 | 60.0 | 28 | 93.3 | 10 | 33.3 | 19 | 63.3 | 17 | 56.7 | | |
| • 23-28 | 4 | 13.3 | 0 | 0 | 2 | 6.7 | 0 | 0 | 11 | 36.7 | 1 | 3.3 | | |
| Blood pressure | | | | | | | | | | | | | | |
| • High | 21 | 70.0 | 3 | 10.0 | 20 | 66.7 | 4 | 13.3 | 22 | 73.3 | 1 | 3.3 | 8.573 | .001** |
| • Low | 2 | 6.7 | 2 | 6.7 | 2 | 6.7 | 26 | 86.7 | 2 | 6.7 | 0 | 0 | | |
| • Normal | 7 | 23.3 | 25 | 83.3 | 8 | 26.7 | 0 | 0 | 6 | 20.0 | 29 | 96.7 | | |

*Significant at P value <0.05

** High significant at P value <0.001

F: ANOVA test

Table (5): Percent distribution of physiological parameters of the lavender oil group before and after AVF puncture (n=30):

| Physiological parameters | Lavender oil Group n=30 | | | | | | | | | | | | F | P - value | |
|--------------------------|--|------|--------------------|------|---------------------------------------|------|--------------------|------|---------------------------------------|------|--------------------|------|-------|--------------|--|
| | 1 st visit (without lavender) | | | | 2 nd visit (with lavender) | | | | 3 rd visit (with lavender) | | | | | | |
| | Pre- AVF puncture | | Post- AVF puncture | | Pre- AVF puncture | | Post- AVF puncture | | Pre- AVF puncture | | Post- AVF puncture | | | | |
| | N. | % | N. | % | N. | % | N. | % | N. | % | N. | % | | | |
| Heart rate | | | | | | | | | | | | | | | |
| • 62-75 | 2 | 6.7 | 9 | 30.0 | 2 | 6.7 | 10 | 33.3 | 2 | 6.7 | 13 | 43.3 | 1.311 | .050* | |
| • 76- 85 | 21 | 70.0 | 21 | 70.0 | 22 | 73.3 | 20 | 66.7 | 24 | 80.0 | 17 | 56.7 | | | |
| • 86- 100 | 7 | 23.3 | 0 | 0 | 6 | 20.0 | 0 | 0 | 4 | 13.3 | 0 | 0 | | | |
| Respiratory Rate | | | | | | | | | | | | | | | |
| • 12-17 | 2 | 6.7 | 16 | 53.3 | 3 | 10.0 | 13 | 43.3 | 1 | 3.3 | 15 | 50.0 | 4.571 | .036* | |
| • 18-22 | 23 | 76.7 | 13 | 43.3 | 13 | 43.3 | 16 | 53.3 | 17 | 56.7 | 15 | 50.0 | | | |
| • 23-28 | 5 | 16.7 | 1 | 3.3 | 14 | 46.7 | 1 | 3.3 | 12 | 40.0 | 0 | 0 | | | |
| Blood pressure | | | | | | | | | | | | | | | |
| • High | 14 | 46.7 | 4 | 13.3 | 21 | 70.0 | 9 | 30.0 | 18 | 60.0 | 3 | 10.0 | 38.91 | .067 | |
| • Low | 2 | 6.7 | 2 | 6.7 | 2 | 6.7 | 2 | 6.7 | 2 | 6.7 | 2 | 6.7 | | | |
| • Normal | 14 | 46.7 | 24 | 80.0 | 7 | 23.3 | 19 | 63.3 | 10 | 33.3 | 25 | 83.3 | | | |

*Significant at P value <0.05

** High significant at P value <0.001

F: ANOVA test

Table (6): Correlation between physiological parameters and level of pain before (1st visit), after application of cryotherapy versus lavender oil inhalation (2nd visit), and in follow up (3rd visit) (n=60):

| Physiological parameters | Pain rating score of Cryotherapy (N=30) | | | | | | Pain rating score of Lavender oil (N=30) | | | | | |
|--------------------------|--|--------------|-----------|--------------|-----------|---------------|---|-------|-----------|------|-----------|-------|
| | 1st visit | | 2nd visit | | 3rd visit | | 1st visit | | 2nd visit | | 3rd visit | |
| | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| | R | R | R | R | R | R | R | R | R | R | R | R |
| P | P | P | P | P | P | P | P | P | P | P | P | |
| Heart rate | .000 | .451* | .355 | .398* | .100 | .183 | -.138 | .024 | -.094 | .052 | .055 | .235 |
| | 1.000 | .012 | .055 | .029 | .600 | .334 | .468 | .902 | .623 | .785 | .771 | .210 |
| Respiratory Rate | .095 | -.056 | -.351 | -.306 | .107 | -.027 | .183 | .192 | -.011 | .133 | .112 | .167 |
| | .618 | .767 | .057 | .101 | .574 | .886 | .334 | .310 | .954 | .484 | .555 | .379 |
| Blood pressure | -.338 | .337 | .109 | -.168 | .006 | -.415* | .279 | -.070 | .139 | .054 | .053 | -.079 |
| | .068 | .068 | .568 | .374 | .977 | .023 | .135 | .713 | .465 | .777 | .782 | .676 |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed)

Discussion

Patients receiving hemodialysis continue to express serious concerns about the pain brought on by the repetitive insertion of hemodialysis needles into AVF. Patients continue to

experience chronic pain for the rest of their lives or until a successful kidney transplant. As a result, the highest priority in dialysis care should be pain management during AVF needling (Canaud, Ponce, Parisotto, Apel, Rammo, et al., 2019).

The demographic characteristics of the studied groups revealed no significant differences regarding their age, gender, marital status, occupation, educational levels, and their residence that may have affected the results; this suggests that the two study groups were homogeneous. This result is in accordance with *Aghajanloo, Ghafourifard, Haririan & Gheydari (2016)* who showed that there were no statistically significant differences between both control and intervention groups. Additionally, *Bagheri-Nesami, Espahbodi, Nikkhah, Shorofi & Charati (2014)* reported in their study about the effects of lavender aromatherapy on pain following needle insertion into a fistula in hemodialysis patients that there weren't significant differences between the experimental and control groups.

More than half of the studied patients in both groups (Cryotherapy & Lavender oil inhalation group) had 50 or more years old, with a mean age of 46.93 and the dominant gender was male. Those results are in the same line with the findings of *Şahin, Tokgöz, and Demir (2021)* who discovered that the majority of their studied patients were men over 50 years old with a mean age of 50.75. Also, *Al Amer, Dator, Abunab & Mari (2017)* found that the majority of the respondents were in the age range "45–64" years. This might be explained by the fact that advanced age was a significant risk factor for the incidence of chronic renal failure.

The study revealed that about three fourths of the studied groups were married and nearly half of them had intermediate education. This is in the same line with *Sharma & Kaur (2020)* who reported in their study entitled "Effectiveness of cryotherapy on pain intensity at puncture sites of arteriovenous fistula on patients with hemodialysis in dialysis unit of a tertiary care hospital, Ludhiana, Punjab" that the majority of patients were married and had senior secondary educational status.

Regarding the differences between the studied groups in relation to their medical data, the researchers found in their study findings that, there were no statistically significant differences between the two groups. This result comes in accordance with *Arab, Bagheri-Nesami, Mousavinasab, Espahbodi &*

Pouresmail (2017) who reported in their study entitled "Comparison of the effects of hegu point ice massage and 2% lidocaine gel on arteriovenous fistula puncture-related pain in hemodialysis patients: a randomized controlled trial" that there were no statistically significant differences in terms of clinical characteristics of hemodialysis patients.

Concerning the duration of Chronic Kidney disease, the study result revealed that nearly one third of both groups (30%) made HD from their fistula site from 1- less than 3 years and more than one third (36.7%) of lavender oil inhalation group from 3-less than 8 years. These results are in the same line with *Shehab (2019)* who found in his study entitled "Effectiveness of Cryotherapy related pain management among patients undergoing hemodialysis at the site of arteriovenous fistula puncture" that two fifth of the studied patients had Chronic Kidney disease from 5-10 years. Additionally, the present study found that the mean HD from fistula was 4.94 years that's agree with *Mirzaei, Javadi, Eftekhari, Hatami & Hemayati (2018)* who said that the mean hemodialysis time of the patients was 4.98 years.

About three fourths of both studied groups (Cryotherapy& lavender oil) (70%, 76.7 % respectively) had left arm fistula. This result agrees with those obtained by *Nasirzadeh, Mircheraghi, Ghodrati & Shareinia (2019)* who revealed that more than half (58.6%) of the studied patients had left arm fistula. In contrast, *Shehab (2019)* said that 56.7% of the studied patients had right arm fistula. This difference may be related to variations in study parameters.

In regard to the presence of comorbidities, the study results found that 86.7%, 76.7 % of studied groups (Cryotherapy& lavender oil) had other diseases and the majority of them (92.3%, 91.4% respectively) had diabetes mellitus and hypertension. It is consistent with *Ghoreyshi, Amerian, Amanpour & Ebrahimi (2018)* who revealed that Hypertension alone and together with diabetes were the most prevailing diseases in the studied patients. Additionally, *Aliasgharpour, Abbaszadeh, Mohammadi & Kazemnejad (2016)* stated that Hypertension along with diabetes were the most frequent cause of chronic renal failure.

Concerning the pain level among patients in both studied groups before and after application of cryotherapy versus lavender oil inhalation, the study revealed that the level of pain was reduced in both groups after application of cryotherapy versus lavender oil inhalation and in follow-up compared to before application of cryotherapy versus lavender oil inhalation, which support the first hypothesis of the study. However, the cryotherapy group's level of pain is less than the lavender oil inhalation group's level of pain after application of cryotherapy versus lavender oil inhalation and in the follow up, which support the second hypothesis of the study. It is coherent with *Elhalafawy, Bahgat, Abd-Elhafez & Farag (2020)* who concluded that both cryotherapy and aromatherapy had a positive effect in reduction of AVF puncture pain, but cryotherapy was more effective in pain reduction than aromatherapy. Also, *Ghoreyshi, Amerian, Amanpour & Ebrahimi (2018)* illustrated in their study entitled "Evaluation and Comparison of the Effects of Xyla-P Cream and Cold Compress on the Pain Caused by the Cannulation of Arteriovenous Fistula in Hemodialysis patients" that cold compress is more effective than Xyla-P cream in reducing the intensity of the pain.

Moreover, *Arab, Bagheri-Nesami, Mousavinasab, Espahbodi & Pouresmail (2017)* who comparing the effects of Hegu Point Ice Massage and 2% Lidocaine Gel on Arteriovenous Fistula Puncture-Related Pain in Hemodialysis Patients, found that Lidocaine gel and Hegu point ice massage affect the intensity of fistula puncture related pain in hemodialysis patients. Given the higher effectiveness of Hegu point ice massage. As well as *Aghajanloo, Ghafourifard, Haririan & Gheydari (2016)* concluded that cryotherapy as a non-pharmacological approach was effective in reducing the pain associated with AVF cannulation.

In addition, *Jafari-Koulaee, Moosazadeh, Bagheri Nesami & Goudarzian (2020)* came to the conclusion in their study entitled "Effect of cryotherapy on arteriovenous fistula puncture-related pain in hemodialysis patients: A systematic review and meta-analysis" that, cryotherapy is effective and useful in relieving

AVF puncture pain and ultimately reducing its unpleasant psychological and physical side effects. Also, *Al Amer, Dator, Abunab & Mari (2017)* reported in their study about "Cryotherapy intervention in relieving arteriovenous fistula cannulation-related pain among hemodialysis patients at the King Khalid Hospital, Tabuk, Kingdom of Saudi Arabia" that cryotherapy is effective in reducing AVF puncture pain of hemodialysis patients. Also, *Porramezani1, Goghary, Firouzabadi, Balvardi & Irannejad-Parizi (2019)* concluded that cryotherapy can be recommended as an efficient noninvasive approach for hemodialysis patients to relieve puncture pain since it lessens the intensity of the pain associated with arteriovenous fistula catheterization.

Considering the high frequency of chronic renal failure, the large increase in hemodialysis patients, and their significant need for nursing care. Cryotherapy application and lavender oil inhalation is shown to be beneficial in alleviating AVF puncture associated pain. Additionally, cryotherapy is the most effective, so it could be employed as a safe, straightforward, and inexpensive way in nursing care.

Conclusion

According to the study's results, it can be concluded that both cryotherapy and lavender oil inhalation positively affected AVF puncture pain among HD patients, but cryotherapy was more effective than lavender oil inhalation on alleviating AVF puncture pain. This is demonstrated by the lack of a statistically significant difference in pain scores between the studied groups before applying cryotherapy versus inhaling lavender oil ($p=.062$). Cryotherapy application versus lavender oil inhalation resulted in a statistically significant difference in pain scores between the study group on the second visit ($p=.037$). and a highly statistically significant difference in the third visits' pain ratings scores between them ($p =.001$). Additionally, in the second and third visits following application of cryotherapy versus lavender oil inhalation, mean scores of pain for the cryotherapy group were lower than those for the lavender oil group.

Recommendations

The following recommendations are suggested in the light of the findings of the current study:

- The application of cryotherapy for HD patients should be considered part of the routine care in HD units for alleviating AVF puncture pain.
- Establishing a training program on the effects of lavender oil inhalation and cryotherapy application as a non-pharmacological technique of reducing AVF puncture pain.
- Additional research should be done to assess the effects of cryotherapy application and lavender oil inhalation on a variety of painful procedures in order to verify their efficacy.

Acknowledgements

We appreciate the cooperation of all the patients who consented to participate in the study as well as the staff who worked in the study area.

Financial support:

No funding was received.

Conflict of interest:

No

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