

Effect of Cryotherapy versus Aromatherapy on Pain of Arteriovenous Fistula Puncture for Children Undergoing Hemodialysis

Seham Eid Hashem Elhalafawy¹, Rahma Soliman Bahgat², Maher Ahmed Abd-Elhafez³, Nagafa Hafez Farag⁴.

1(Assistant Lecturer of Pediatric Nursing, Faculty of Nursing / Tanta University, Egypt).

2(Professor of Pediatric Nursing, Faculty of Nursing / Tanta University, Egypt).

3(Professor of Pediatrics, Faculty of Medicine / Tanta University, Egypt).

4(Lecturer of Pediatric Nursing, Faculty of Nursing / Tanta University, Egypt)

Abstract :

Background: ArterioVenous Fistula (AVF) puncture pain is a major stressful experience facing children undergoing hemodialysis (HD). Complementary therapies such as cryotherapy and aromatherapy are used to manage pain. **The study aimed** to evaluate the effect of cryotherapy versus aromatherapy on pain of arteriovenous fistula puncture for children undergoing HD. **Subjects and method:** A convenience sampling of sixty children undergoing hemodialysis with AVF participated in the study. The study was conducted at Dialysis Unit of Pediatric Medical department of Tanta Main University Hospital (TUH) and Dialysis Unit of Elmenshawy Hospital. **Three Tools were** used to collect data: Structured Interview Schedule, Wong Baker faces pain Rating Scale and Observational Scale of Behavioral Distress. **The results** revealed that during fistula puncture, mean Wong Baker faces pain and total behavioral distress scale scores was lower among children in cryotherapy group than those in aromatherapy. Post cryotherapy, children had lower mean pulse, respiration and higher mean O₂ saturation than pre cryotherapy. **The study concluded** that both cryotherapy and aromatherapy had a positive effect in reduction of AVF puncture pain for children undergoing HD but cryotherapy was more effective in pain reduction than aromatherapy. **The study recommended** that application of ice massage should to be endorsed as a part of the routine care for hemodialysis children to reduce fistula puncture pain.

Keywords: Arteriovenous fistula, Aromatherapy, Children, Cryotherapy, Hemodialysis, Pain

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I. Introduction

Chronic Kidney Disease (CKD) is a condition characterized by irreversible kidney damage that can further progress slowly to End Stage Renal Disease (ESRD). It is recognized as a major health problem with high cost on the community⁽¹⁾. Hemodialysis is the most frequently used therapy for CKD that involve removing wastes and extra fluid from the blood through diffusion of solute molecules through semi permeable membrane called a dialyzer, passing from higher concentration to lower concentration to filtering the blood⁽²⁾.

For HD, a surgeon creates an access to the bloodstream, called a vascular access which mostly is arteriovenous fistula. On average, children undergo HD three sessions weekly, each session lasting three to four hours. They face pain experience every session during AVF cannulation that considered one of the most necessary causes of treatment rejection among them. The frequent pain induced by fistula puncture can result in depression, avoidance or shortening of session duration and stress for those children^(3,4).

Whereas applying pain management techniques can lead to the acceptance of treatment and improving their quality of life. So, the nurses should be encouraged to promote pain management as a clinical and research priority and basic child right for those children. Management of pain includes pharmacological and non-pharmacological measures. Non-pharmacological measures include massage, distraction and electrical nerve stimulation through either heat or cold application⁽⁵⁾.

Cryotherapy has been acknowledged as a compelling non-pharmacologic intervention for pain management and ice has been used for centuries as a topical pain reliever. It is easy to learn and inexpensive strategy that expands the pain threshold. It also decreases the inflammatory response and spasm. Ice massage produces cold stimulus as indicated by gate control theory as it inhibits the transmission of pain signals through hinder brain stimulation and perception of pain by the person^(6,7).

Aromatherapy is another non-pharmacological approaches that it is defined as the therapeutic use of essential oils that extracted from plants. It is an alternative form of therapy that uses essential oils in order to improve well being of body and brain and mood. Lavender oil, obtained from the plant named as *Lavandula angustifolia* Mill. Lavender oil has many therapeutic actions such as reducing anxiety, pain reliever, antispasmodic, antifungal, antimicrobial, and wound healing properties ⁽⁸⁾.

After inhalation of lavender, its particles are transmitted through the nose to the limbic system and this area is closely connected with other systems that control memory, emotions and hormones, it results in release of various neurotransmitters such as enkephalin, endorphins and serotonin which ultimately lead to reduction of stress and pain ⁽⁹⁾.

II. Aim of the study

The study was conducted to evaluate the effect of cryotherapy versus aromatherapy on pain of arteriovenous fistula puncture for children undergoing hemodialysis.

III. Subjects and Method

This is a quasi-experimental research design. The study was conducted at; Dialysis Unit of Pediatric Medical department of Tanta Main University Hospital (TUH) and Dialysis Unit of Elmenshawy Hospital.

Sample I: A convenience sampling of sixty children, were included in the study. The sample size was based on the following parameters confidence level error level 5% type I error 0.05 and power of test 90%. They were selected and divided randomly (using simple random method) into two equal groups namely: **Group (I):** Thirty children who received cryotherapy. **Group (II):** Thirty children who exposed to aromatherapy. Children having the following criteria; both sexes, aged from 6-15 years, capable of verbal and non verbal communication, conscious and willing of them and their parents to participate in the study and have functioning AVF.

Three tools were used to collect data:

Tool I: Structured interview Schedule: It consisted of three parts: Part one: Sociodemographic characteristics of the studied children: The form covered the personal characteristics of the studied children, including their age, sex, educational level and residence. Part two: It covered the medical history of children including the duration of their disease and co-morbidities, the duration and frequency of their hemodialysis and the characteristics of their AVF as site, duration and their pain expression. Part three: It included data about the child caregiver such as their age, educational level and their child pain history.

Tool II: Subjective pain assessment by using Wong–Baker faces pain rating scale ⁽¹⁰⁾:

It was adopted from Wong (1988). It was used as a self-report scale to measure the subjective pain intensity of children during fistula puncture. It included six drawn faces expressing various degrees of pain, severity ranging from “does not hurt” to “hurts very much”. These faces were assigned scores from 0 to 10, with a higher score indicating a higher severity of pain.

Scoring system of Wong–Baker faces pain rating Scale: No pain (0), mild pain :(1-3), moderate pain: (4-6) and sever pain :(7-10).

Tool III: It consisted of three parts: **Part one: Observational Scale of Behavioral Distress (OSBD) ⁽¹¹⁾:** It was adopted from **Elliot (1987)**. It was used to observe children's behavioral reactions before, during and after fistula puncture which indicate discomfort (cry, scream, physical restraint, verbal resistance, emotional support, information seeking, verbal pain and flail) at 15 second intervals throughout the procedure (fistula puncture), giving them score according to the severity of distress shown by the child. The scores were summed for each 15 second interval within phases of the procedure and then were divided by the number of intervals to obtain a mean score. Each item was classified into (4) points according to the severity of distress whereas: severe distress (4), moderate distress (3), mild distress (2) and no distress (1). The total score of OSBD: 70 % and more indicated severe distress, Moderate distress if the score was 60 % - >70 % , mild distress if: 50% - > 60% and Less than 50% indicate no distress.

Part two: The physiological measurements that could be influenced by pain were assessed before, during and after needle insertion. These measurements included respiratory rate, pulse, blood pressure and oxygen saturation. **Part three:** Assessment of the AFV puncture site: It was done before and after cryotherapy implementation to detect any local skin reaction from cryotherapy, such as ecchymosis, swelling and skin dryness.

Method

This study was approved by Research Ethical Committee REC of Faculty of Nursing at (TUH) 12-1-2018. **Oral consents** were obtained from parents and their children to participate in the study after explaining the aim of the study and their right to withdraw from the study at any time without providing a reason and without any potential. The tools were presented to a jury of five experts in the field of pediatric nursing, nephrology and community health nursing to check content validity, clarity, relevance, comprehensiveness,

understanding, applicability and ease for implementation. Content validity index was 98.8%. To assess **reliability**, the study tools were tested and the value of Cronbach's alpha coefficient was 0.881. A **pilot study** was carried out on (10%) of children to test the tools for its clarity, applicability, feasibility and the necessary modification was done Pilot study was excluded from total sample of the study.

Implementation of the study: The study was conducted through three phases:

1-Assessment phase: It was done by the researcher for all studied subjects to assess children who meet the inclusion and exclusion criteria then the researcher, firstly met dialysis nurses and resident doctors to explain the purpose of the study to gain their cooperation. Children and their parent were interviewed by the researcher in the waiting room.

2-Implementation phase: The researcher attended at 6:30 am or 6:45am till 8:45 am every day except Friday to collect the data. The parents were asked about sociodemographic and clinical data of their children to fill questions of tool one. This step took about 10 minutes. Then, the researcher explained Wong Baker faces pain rating scale to the children and taught them on how to apply this scale by using printed colored paper.

During the first two dialysis sessions (first and second day): the researcher recorded the physiological measurements of children Tool III part three before needle puncture. ArterioVenous Fistula (AVF) puncture sites were sterilized by nurses according the routine care of the unit. As the dialysis nurse performed the needle puncture, the researcher observed and recorded the behavior of children using Tool III part one at 15 second intervals throughout the puncture of fistula.

Physiological measurements of children were reassessed after puncture then the child asked to fill the subjective pain scale. The same process was repeated in the next dialysis session. **During the next two dialysis sessions** (third and fourth day): The researcher applied the intervention either implementation of cryotherapy or inhalation of lavender:

Group I (Cryotherapy group): Massage with ice was done by the researcher over the AVF puncture site by using slow circular fixed interrupted motions until numbness was felt by the child.

Group II (Aromatherapy group): two drops of 100% pure organic lavender oil was poured on cotton that was fixed by the child at 5 cm distance from the child's nose and asked him to breathe slowly with his eyes closed for 15 minutes. The nurse began cannulation and pain was measured as mentioned before. **Before insertion of needle,** The researcher reassessed the AVF puncture site before the needle puncture to detect any local skin reaction from cryotherapy and this step took about 1 minute.. Then the nurse inserted the needle while the child was still observed by the researcher to record his or her behavior during needle insertion and asked about numbness sensation disappeared and time of massage application.

3- Evaluation phase: It was done to children in both groups regarding pain level subjectively using tool II and objectively using tool III in four consecutive sessions to assess degree of pain during insertion of needles pre and post intervention. The data was collected over a period of six months from beginning of March 2018 to August 2018.

Statistical analysis:

The collected data were organized, tabulated and statistically analyzed using SPSS software (Statistical Package for the Social Sciences, version 23, SPSS Inc. Chicago, IL, USA). For quantitative data, the range, mean and standard deviation were calculated. For qualitative data, comparison between two groups and more was done using Chi-square test (χ^2). For comparison between means of two groups of non-parametric data of independent samples, Z value of Mann-Whitney test was used. For comparison between means of two groups of parametric data of independent samples, student t-test was used. For comparison between more than two means of parametric data, F value of ANOVA test was calculated. For comparison between means of two related groups (before and after intervention) of parametric data of paired t-test was used. For comparison between more than two means of non-parametric data, Kruskal-Wallis (X2 value) was calculated. For comparison between means of three or more related groups (χ^2 value) of Friedman test was calculated for non-parametric data. Correlation between variables was evaluated using Pearson's correlation coefficient (r). Significance was adopted at $P < 0.05$ for interpretation of results of tests of significance⁽¹²⁾.

IV. Result

Table (1): As regards the age, it was evident that more than half of children (56.7%) and 43.3% were between 12 -15 years old with the mean age (11.37±2.84 and 11.27±2.67) years in cryotherapy and aromatherapy group respectively. In relation to sex, it was clear that 60% and two third (66.7%) of children were females respectively, in cryotherapy and aromatherapy group.

Regarding their residence, most of children (80%) and more than two third (66.35%) of them respectively were from rural areas in each of cryotherapy and aromatherapy group. Regarding their educational level, it was found that 60% of children in cryotherapy group were in primary school, while half of children (50%) of the aromatherapy group were in preparatory school.

Figure (1): Regarding cryotherapy group, it was observed that the mean score of Wong Baker faces pain score during fistula puncture was 7.266 and 5.667 respectively in day 1 and 2 which decreased to 2.666 and 1.733 respectively in day 3 and 4. While aromatherapy group, it was evident that the mean score of Wong Baker faces pain rating scale during fistula puncture was 6.66 and 6.20 respectively in day 1 and 2 which decreased to 4.86 and 4.13 respectively in day 3 and 4.

Table (2): clarifies percentage distribution of the studied children according to their level of behavioral distress scores before, during and after fistula puncture. It was found that there were statistically significant differences among children in the cryotherapy group where (P=0.000, P=0.000, and P=0.017) respectively before, during and after fistula puncture regarding their level of behavioral distress scores in 1st, 2nd, 3rd and 4th day.

Moreover, during fistula puncture half and nearly half (46.7%) of the children of cryotherapy group had mild behavioral distress score in the 1st and 2nd day respectively. While after implementation of cryotherapy, most of them (86.7%) and all of them respectively had no distress in the 3rd and 4th day. Regarding aromatherapy group, it was observed that half and more than half (53.3%) of children respectively had mild behavioral distress score in the 1st and 2nd day before lavender inhalation while after it less than 60% and 80% of them respectively had no behavioral distress in the 3rd and 4th day.

In addition, there were statistically significant differences among children in aromatherapy where (P=0.000 and P=0.000) respectively before and during fistula puncture regarding their severity level of behavioral distress scores that became not significant after fistula puncture where (P=0.388) in 1st, 2nd, 3rd and 4th day. Also, it was clear that there were statistically significant differences among children of both groups before, during and after fistula puncture where (P=0.000, P=0.000, P=0.001 and P=0.000) respectively in 1st, 2nd, 3rd and 4th day regarding their level of behavioral distress.

Table (3) demonstrates distribution of the studied children according to their mean change of total severity level of behavioral distress scores before, during and after fistula puncture. It was noticed that mean \pm SD of change in total behavioral distress scores pre and post the intervention (II than I) was $\downarrow 4.383 \pm 2.15$, $\downarrow 4.850 \pm 2.88$ and $\downarrow 3.183 \pm 1.76$ respectively before, during and after fistula puncture among children in cryotherapy group.

In contrast to aromatherapy group, mean \pm SD of change in total behavioral distress scores pre and post the intervention (II than I) among children was $\downarrow 2.400 \pm 2.53$ before fistula puncture then became $\downarrow 3.800 \pm 3.10$ during fistula puncture and became $\downarrow 0.850 \pm 2.32$ after fistula puncture. The table also showed that there were significant differences where (P=0.000, P=0.000 and P=0.000) respectively before, during and after fistula puncture among children of cryotherapy and aromatherapy group regarding the mean change of total severity level of behavioral distress scores.

In addition, there were statistically significant differences between the studied children where (P=0.000, P=0.020, and P=0.000) respectively before, during and after fistula puncture regarding total behavioral distress scores pre the intervention (I) between cryotherapy and aromatherapy group in day 1 and 2. Also, there were statistically significant differences between the studied children where (P=0.000, P=0.002, and P=0.000) respectively before, during and after fistula puncture respectively regarding total behavioral distress scores post the intervention (II) between cryotherapy and aromatherapy group in day 3 and 4.

Table (4) presents correlation between Wong Baker pain scores of the studied children of both groups and their physiological measurements before, during and after fistula puncture. Regarding respiration, it was revealed that there was positive significant correlation where (P=0.027) between it and Wong Baker faces scores in fourth day during fistula puncture in cryotherapy group. While in aromatherapy group, there was positive significant correlation where (P=0.029) between it and Wong Baker pain scores in third day before fistula puncture.

There was negative non significant correlation between pulse and Wong Baker pain scores before, during and after fistula puncture among children in both groups in 3rd and 4th day. In relation to systolic and diastolic blood pressure, there was positive significant correlation where (P=0.003 and P=0.029) respectively between them and Wong Baker pain scores in third day during fistula puncture among children of cryotherapy group. In addition, there was negative significant correlation where (P=0.035) between O₂ saturation and Wong Baker faces scores in third day before fistula puncture among children of cryotherapy group. While in aromatherapy group a negative significant correlation was observed where (P=0.038) in the same day but after fistula puncture.

Table (5) explains correlation between behavioral distress scores (severity) of the studied children of cryotherapy and aromatherapy group and their sociodemographic and hemodialysis characteristics. It was found

that there was negative non significant correlation between age and sex of children in both groups and their behavioral distress scores before, during and after fistula puncture in 3rd and 4th day.

A positive non significant correlation was revealed between behavioral distress scores and duration of disease among children of both groups except in 3rd day where it became significant where (P=0.033) among children of cryotherapy group during fistula puncture. A positive non significant correlation was found between duration of fistula and hemodialysis among children in both groups and their behavioral distress scores before, during and after fistula puncture in 3rd and 4th day.

Table (6) presents correlation between behavioral distress scores and physiological measurements among the studied children of both groups. Regarding respiration, there was negative significant correlation where (P=0.008, P=0.044 and P=0.033) respectively between it and behavioral distress scores during and after fistula puncture in 3rd day and before fistula puncture in the 4th day for cryotherapy group children.

In addition, there was negative non significant correlation between pulse and behavioral distress scores and after fistula puncture where (P=0.101 and P=0.702) respectively among children of cryotherapy group in 3rd and 4th day. Concerning systolic blood pressure, there was positive significant correlation where (P=0.005) between it and behavioral distress scores in third day during fistula puncture among children of cryotherapy group. In addition, there was negative non significant correlation between O₂ saturation and behavioral distress scores before, during and after fistula puncture among children in both groups in 3rd and 4th day.

Table (1): Percentage distribution of the studied children according to their sociodemographic characteristics

| Characteristics of the studied children | Group I (Cryotherapy) (n=30) | | Group II (Aromatherapy) (n=30) | |
|---|------------------------------------|------|--------------------------------------|------|
| | No. | % | No. | % |
| Age (years): | | | | |
| 6->9 | 6 | 20 | 6 | 20.0 |
| 9->12 | 7 | 23.3 | 11 | 36.7 |
| 12->15 | 17 | 56.7 | 13 | 43.3 |
| Range | 6 -15 | | 6 -15 | |
| Mean ± SD | 11.37 ± 2.84 | | 11.27 ± 2.67 | |
| Median | 12.0 | | 11.5 | |
| Sex: | | | | |
| Male | 12 | 40.0 | 10 | 33.3 |
| Female | 18 | 60.0 | 20 | 66.7 |
| Residence: | | | | |
| Urban | 6 | 20 | 10 | 33.3 |
| Rural | 24 | 80 | 20 | 66.7 |
| Educational level: | | | | |
| Primary school | 18 | 60.0 | 15 | 50 |
| Preparatory school | 10 | 33.3 | 13 | 43.3 |
| Secondary school | 2 | 6.7 | 2 | 6.7 |

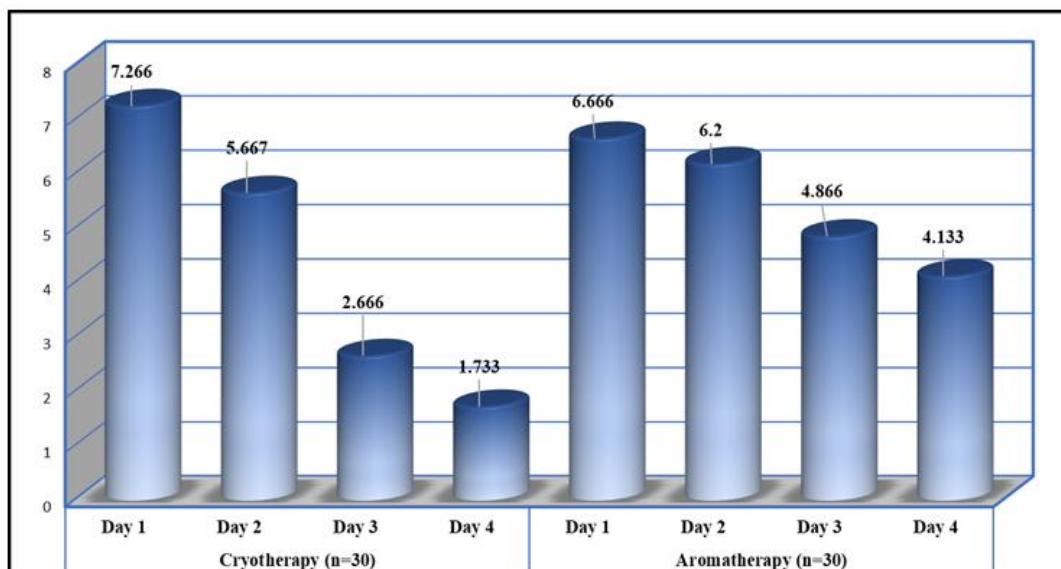


Figure (1): Mean score of the studied children according to their Wong Baker faces pain rating scale scores during needle insertion

Table (2): Percentage distribution of the studied children according to their level of behavioral distress scores before, during and after fistula puncture

| Level of behavioral distress scores before, during and after fistula puncture | The studied children (n=60) | | | | | | | | | | | | | | | | χ ² P | |
|---|------------------------------|------|------------------|------|------------------|-------|------------------|-------|---------------------|--------------------------------|------|-------|-------|-------|-------|-------|---------------------|------------------|
| | Group (I) Cryotherapy (n=30) | | | | | | | | χ ² P | Group (II) Aromatherapy (n=30) | | | | | | | | |
| | Day1 | | Day 2 | | Day3 | | Day 4 | | | Day1 | | Day 2 | | Day 3 | | Day 4 | | |
| No | % | No | % | No | % | No | % | No | % | No | % | No | % | No | % | No | % | |
| Before fistula puncture: | | | | | | | | | | | | | | | | | | |
| No distress (<50%) (8 -15) | 8 | 16.6 | 15 | 50.0 | 27 | 90.0 | 30 | 100.0 | 52.674 | 11 | 36.7 | 16 | 53.3 | 24 | 80.0 | 28 | 93.3 | 27.677 0.000* |
| Mild distress (50% -<60%) (16 -19) | 16 | 53.3 | 12 | 40.0 | 3 | 10.0 | 0 | 0.0 | 0.000* | 14 | 46.7 | 12 | 40.0 | 5 | 16.7 | 2 | 6.7 | |
| Moderate distress (60% -<70%) (20 - 22) | 3 | 10.0 | 3 | 10.0 | 0 | 0.0 | 0 | 0.0 | | 5 | 16.7 | 2 | 6.7 | 1 | 3.3 | 0 | 0.0 | |
| Severe distress (≥70%) (23 - 32) | 3 | 10.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | | | | | | | | | | |
| During fistula puncture: | | | | | | | | | | | | | | | | | | |
| No distress (<50%) (8 -15) | 5 | 16.7 | 12 | 40.0 | 26 | 86.7 | 30 | 100.0 | 63.366 0.000* | 3 | 10.0 | 5 | 16.7 | 18 | 60.0 | 24 | 80.0 | 49.290 0.000* |
| Mild distress (50% -<60%) (16 -19) | 15 | 50.0 | 14 | 46.7 | 3 | 10.0 | 0 | 0.0 | | 15 | 50.0 | 16 | 53.3 | 11 | 36.7 | 6 | 20.0 | |
| Moderate distress (60% -<70%) (20 - 22) | 7 | 23.3 | 4 | 13.3 | 1 | 3.3 | 0 | 0.0 | | 10 | 33.3 | 8 | 26.7 | 1 | 3.3 | 0 | 0.0 | |
| Severe distress (≥70%) (23 - 32) | 3 | 10.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | | 2 | 6.7 | 1 | 3.3 | 0 | 0.0 | 0 | 0.0 | |
| After fistula puncture: | | | | | | | | | | | | | | | | | | |
| No distress (<50%) (8 -15) | 25 | 86.7 | 28 | 93.3 | 30 | 100.0 | 30 | 100.0 | 10.164 0.017* | 29 | 96.7 | 30 | 100.0 | 30 | 100.0 | 30 | 100.0 | 3.025 0.388 |
| Mild distress (50% -<60%) (16 -19) | 5 | 13.3 | 2 | 6.7 | 0 | 0.0 | 0 | 0.0 | | 1 | 3.3 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | |
| χ ² (Cryotherapy vs Aromatherapy) P | 89.598 0.000* | | 87.152 0.000* | | 29.630 0.001* | | 23.023 0.000* | | | | | | | | | | | |

*Statistically Significant difference at (P<0.05)

Table (3): Distribution of the studied children according to their mean change of severity level of behavioral distress scores before, during and after fistula puncture

| Total behavioral distress scores (severity) of observed behavioral reactions | The studied children (n=60) | | | | | | | | t- test P | |
|--|------------------------------|------------|------------|------------|--------------------------------|------------|------------|------------|-----------|--------|
| | Group (I) Cryotherapy (n=30) | | | | Group (II) Aromatherapy (n=30) | | | | (I) | (II) |
| | (I) | | (II) | | (I) | | (II) | | | |
| | Day1 | Day 2 | Day3 | Day 4 | Day1 | Day 2 | Day 3 | Day 4 | | |
| Before fistula puncture: | | | | | | | | | | |
| Range | 11 - 23 | 11 - 21 | 10 - 17 | 8 - 14 | 12 - 22 | 11 - 22 | 11 - 20 | 10 - 18 | 7.968 | 6.473 |
| Mean ± SD | 17.26±2.95 | 15.83±2.46 | 13.60±1.95 | 10.73±1.68 | 16.50±2.87 | 15.46±2.76 | 14.20±2.18 | 12.96±1.86 | 0.000* | 0.000* |
| Change (II) than (I) | | | | | | | | | | |
| Range | ↓9 - 1 | | | | ↓8 - 4 | | | | | |
| Mean ± SD | ↓4.383±2.15 | | | | ↓2.400±2.53 | | | | | |
| Paired t- test | 15.750 | | | | 7.341 | | | | | |
| P | 0.000* | | | | 0.000* | | | | | |
| During fistula puncture: | | | | | | | | | | |
| Range | 13 - 26 | 13 - 22 | 10 - 20 | 9 - 14 | 14 - 26 | 11 - 24 | 12 - 20 | 9 - 17 | 2.362 | 3.091 |
| Mean ± SD | 18.20±3.24 | 16.30±2.50 | 13.46±2.08 | 11.33±1.47 | 18.63±2.52 | 17.86±2.63 | 15.30±2.08 | 13.60±2.02 | 0.020* | 0.002* |
| Change (II) than (I) | | | | | | | | | | |
| Range | ↓11 - 2 | | | | ↓11 - 3 | | | | | |
| Mean ± SD | ↓4.850±2.88 | | | | ↓3.800±3.10 | | | | | |
| Paired t- test | 13.014 | | | | 9.490 | | | | | |
| P | 0.000* | | | | 0.000* | | | | | |
| After fistula puncture: | | | | | | | | | | |
| Range | 9 - 17 | 9 - 17 | 8 - 13 | 8 - 13 | 10 - 17 | 9 - 15 | 8 - 15 | 8 - 14 | 12.477 | 13.369 |
| Mean ± SD | 13.43±1.86 | 12.70±1.91 | 10.33±1.49 | 9.43±1.27 | 11.90±1.86 | 12.13±1.47 | 11.33±1.68 | 11.00±1.43 | 0.000* | 0.000* |
| Change (II) than (I): | | | | | | | | | | |
| Range | ↓7 - 0 | | | | ↓5 - 5 | | | | | |
| Mean ± SD | ↓3.183±1.76 | | | | ↓0.850±2.32 | | | | | |
| Paired t- test | 14.002 | | | | 2.838 | | | | | |
| P | 0.000* | | | | 0.000* | | | | | |

*Statistically Significant difference at (P<0.05) I (1st and 2nd day-routine care or no intervention)
 II (3rd and 4th day- intervention (ice massage or lavender inhalation)).

Table (4): Correlation between Wong Baker faces scores of the studied children of both groups and their physiological measurements before, during and after fistula puncture

| Physiological measurements of the studied children | Wong Baker pain scores (n=60) | | | | | | | | | | | |
|--|-------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|---------------------------|-----------------|------------------|-----------------|-----------------|-----------------|
| | Cryotherapy group (n=30) | | | | | | Aromatherapy group (n=30) | | | | | |
| | Day3 | | | Day4 | | | Day3 | | | Day4 | | |
| | Before | During | After | Before | During | After | Before | During | After | Before | During | After |
| r | r | r | r | r | r | r | r | r | r | r | r | |
| p | p | p | p | p | p | p | p | p | p | p | p | |
| Respiration | 0.015 0.938 | -0.006 0.974 | -0.084 0.885 | -0.262 0.162 | 0.404 0.027* | -0.048 0.799 | 3980. *0290. | -0.011 0.952 | -0.203 0.281 | 0.147 0.439 | -0.218 0.247 | -0.087 0.648 |
| Pulse | -0.001 0.994 | -0.094 0.622 | -0.056 0.768 | -0.171 0.365 | -0.147 0.439 | -0.108 0.570 | -0.196 0.299 | -0.034 0.859 | -0.249 0.185 | 0.018 0.924 | 0.110 0.563 | 0.036 0.851 |
| Systolic blood pressure | -0.005 0.980 | 0.518 0.003* | -0.056 0.770 | 0.019 0.920 | 0.025 0.897 | -0.097 0.610 | 2310. 2190. | -0.150 0.430 | 0.282 0.131 | 0.244 0.194 | 0.339 0.067 | 0.147 0.439 |
| Diastolic blood pressure | -0.176 0.351 | 0.398 0.029* | -0.176 0.351 | -0.169 0.372 | -0.218 0.247 | -0.172 0.364 | .2270 0.228 | -0.031 0.871 | 0.210 0.266 | 1560. 0.409 | 0.022 0.907 | 0.045 0.814 |
| O2 saturation | -0.357 0.035* | -0.043 0.823 | -0.097 0.609 | -0.043 0.820 | -0.100 0.599 | 0.054 0.776 | 74.01 3570. | -0.191 0.313 | -0.380 0.038* | -0.037 0.844 | 0.009 0.963 | 0.281 0.132 |

*statistically Significant difference at (P<0.05)
 r =Correlation Coefficient

Table (5): Correlation between Observational Scale of Behavioral Distress scores (severity) of the studied children of cryotherapy and aromatherapy group and their sociodemographic and hemodialysis characteristics

| Sociodemographic and hemodialysis characteristics of children | Observational Scale of Behavioral Distress scores (severity) | | | | | | | | | | | |
|---|--|-----------------|-----------------|-----------------|-----------------|-----------------|--------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| | Cryotherapy group(n=30) | | | | | | Aromatherapy group(n=30) | | | | | |
| | Day3 | | | Day4 | | | Day3 | | | Day4 | | |
| | Before | During | After | Before | During | After | Before | During | After | Before | During | After |
| | r | r | r | r | r | R | r | r | r | r | r | r |
| p | p | p | p | p | p | p | p | p | p | p | p | |
| Age in years | -0.200 0.288 | -0.071 0.711 | -0.287 0.125 | -0.254 0.112 | -0.324 0.081 | -0.287 0.125 | -0.166 0.381 | -0.098 0.511 | -0.246 0.189 | -0.172 0.364 | -0.221 0.241 | -0.155 0.415 |
| Sex | -0.023 0.905 | 0.327 0.078 | -0.149 0.433 | -0.150 0.430 | 0.101 0.597 | -0.064 0.738 | -0.058 0.761 | -0.125 0.511 | -0.097 0.609 | -0.202 0.284 | -0.014 0.942 | -0.245 0.193 |
| Duration of disease (months) | 0.350 0.058 | 0.391 0.033* | 0.094 0.621 | 0.123 0.517 | 0.037 0.845 | 0.124 0.515 | 0.089 0.641 | 0.060 0.752 | 0.361 0.164 | 0.065 0.703 | 0.318 0.085 | 0.246 0.190 |
| Duration of hemodialysis (months) | 0.037 0.846 | 0.186 0.325 | 0.067 0.724 | 0.013 0.944 | 0.104 0.584 | 0.184 0.331 | 0.025 0.890 | 0.175 0.356 | 0.156 0.411 | 0.222 0.238 | 0.081 0.669 | 0.071 0.708 |
| Duration of fistula (months) | 0.126 0.509 | 0.008 0.969 | 0.010 0.956 | 0.065 0.770 | 0.289 0.121 | 0.128 0.500 | 0.075 0.694 | 0.043 0.822 | 0.111 0.560 | 0.130 0.495 | 0.085 0.656 | 0.054 0.776 |

*Statistically Significant difference at (P<0.05)

r =Correlation Coefficient

Table (6): Correlation between behavioral distress scores (severity) the studied children of both groups and their physiological measurements

| Physiological measurements of the studied children | behavioral distress scores (severity) among the studied children (n=60) | | | | | | | | | | | |
|--|---|------------------|------------------|------------------|-----------------|-----------------|---------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| | Cryotherapy group (n=30) | | | | | | Aromatherapy group (n=30) | | | | | |
| | Day3 | | | Day4 | | | Day3 | | | Day4 | | |
| | Before | During | After | Before | During | After | Before | During | After | Before | During | After |
| | r | r | r | r | r | r | r | r | r | r | r | r |
| p | p | p | p | p | p | p | p | p | p | p | p | |
| Respiration | -0.051 0.789 | -0.278 0.008* | -0.317 0.044* | -0.391 0.033* | -0.236 0.209 | -0.146 0.443 | -0.047 0.804 | -0.478 0.124 | -0.370 0.081 | -0.008 0.967 | -0.109 0.567 | -0.078 0.681 |
| Pulse | 0.112 0.556 | 0.012 0.951 | -0.305 0.101 | 0.157 0.407 | 0.138 0.469 | -0.073 0.702 | -0.054 0.776 | 0.036 0.850 | -0.201 0.287 | 0.106 0.579 | -0.231 0.220 | 0.152 0.424 |
| Systolic blood pressure | 0.205 0.278 | 0.500 0.005* | 0.186 0.324 | -0.088 0.643 | -0.011 0.956 | 0.287 0.124 | -0.062 0.744 | 0.221 0.241 | 0.110 0.563 | -0.081 0.671 | 0.214 0.257 | 0.075 0.695 |
| Diastolic blood pressure | 0.177 0.349 | -0.140 0.460 | 0.283 0.130 | 0.040 0.835 | 0.010 0.960 | 0.210 0.265 | -0.100 0.598 | 0.006 0.977 | -0.063 0.741 | -0.172 0.365 | 0.312 0.093 | -0.066 0.729 |
| O2 saturation | -0.020 0.916 | -0.084 0.660 | -0.257 0.171 | -0.178 0.347 | 0.060 0.754 | -0.290 0.120 | -0.002 0.991 | -0.118 0.536 | -0.186 0.326 | -0.098 0.607 | -0.034 0.858 | -0.307 0.099 |

*statistically Significant difference at (P<0.05)

r =Correlation Coefficient

V. Discussion

Arteriovenous fistula is an inevitable element for children receiving maintenance hemodialysis. They experienced severe pain during AVF cannulation. Inadequate relief of pain during such distressing procedures may permanently decrease pain tolerance and increase pain responses. The use of complementary therapy has increased as non-pharmacological measures to reduce pain⁽¹³⁾.

Complementary therapies such as cryotherapy and aromatherapy are safer than pharmacotherapy and have few or no side effects. Cryotherapy is the application of any material that removes heat from the body resulting in decreased tissue temperature which produces analgesic effect. As cold application seems to decrease the ability of sensory transmission and thus reduces acetyl-choline release influencing the pain threshold. Aromatherapy is the utilization of vaporizable and unstable oils extracted from aroma plants for many purposes that was used in Egypt as a remedy thousands years ago⁽¹⁴⁾.

The present study showed that pain level after ice massage application decreased from moderate and severe pain in most of children in the first and second day to mild pain and no pain in the third and fourth day.

This result may be explained on the basis that ice massage decreases the skin temperature that result in slowing velocity of conduction of peripheral nerve fibers and decreasing release of inflammatory and nociceptive mediators that lead to skin anesthesia and local anesthetic effect relatively quickly.

Elsayed (2017) was congruent with this result and mentioned that the mean of pain score during AVF puncture reduced in the studied children post application of cryotherapy than pre cryotherapy. They concluded cryotherapy was effective on diminishing pain intensity at puncture sites of AVF among children undergoing hemodialysis⁽¹⁵⁾.

Al Amer (2017) was in same line with this result who noticed that a highly significant difference was found between pre test and post test mean score on level of pain⁽¹⁶⁾. On the other hand, **Waterhouse (2013)** disagreed with this result and stated that vapocoolant spray may be more effective than ice as an analgesic for pediatric intravenous catheter insertion⁽¹⁷⁾.

The current study revealed also that the reduction in the mean of Wong-Baker faces pain score and behavioral distress scores during fistula puncture in the cryotherapy group in fourth day was more than that in third day. There were statistically significant differences between pre and post intervention.

This may could be related to that children in the fourth day became more adapted, relaxed and more interested with the procedure that produce more analgesic effect that observed in the fourth day than third day of application. **Patidar (2015)** and **Canbulat (2015)** results was congruent with this result and they stated that cold application reduced the objective and subjective level of pain during venipuncture in children^(18, 14).

In addition, **Shanmugam (2017)** reported that there was highly statistical significant difference between level of pain before and after application of cryotherapy⁽¹⁹⁾. On the other hand, **Fareed (2014)** disagreed with these results and reported that more than half of the studied children had moderate score of objective pain before using the ice massage while after using it more than two third of them had mild objective pain score during the second session and they had no pain during the third session, respectively⁽²⁰⁾.

As regards aromatherapy group children, the current study revealed that the mean score of pain reduced in the third and fourth day after inhalation of lavender oil than mean of pain score in first and second day where they received routine care. This may be attributed to that the inhaled lavender oil enter directly through the large surface area of the nasal mucosa direct to the brain then exerting its relaxing effects on all body systems and mind.

Bikmoradi (2017) were in the same direction with this result who found that mean of pain severity immediately, five minutes and ten minutes after intravenous catheter insertion had significant differences after aromatherapy inhalation⁽²¹⁾. **Tasana (2019)** were in agreement with this result who found that the pain mean score of vascular access was decreased after the implementation of lavender oil inhalation⁽²²⁾.

Besides, **Ghods (2015)** results were consistent with these results who reported that lavender aromatherapy may be an effective technique to reduce pain following needle insertion into a fistula for patient undergoing hemodialysis⁽²³⁾. While, **Salamaty (2014)** was against this result and found that there was no statistically significant difference before and after aromatherapy and proved that lavender essential oil inhalation has no effect on reducing the pain⁽²⁴⁾. **Lucas (2012)** results also were against this result as they mentioned that inhalation aromatherapy was not effective for reducing anxiety, nausea, or pain among children and adolescents undergoing invasive procedures⁽²⁵⁾.

The result of the present study showed that lavender oil inhalation did not cause any negative side effects on the children undergoing hemodialysis except five of children who felt sleepy. This may be due to the relaxing effect of lavender oil to their body systems. **Tasana (2019)** supported this result and observed that applying lavender oil inhalation to patients undergoing hemodialysis decreased their pain level experienced during vascular access and caused no negative effects on them⁽²²⁾.

The findings of the present study clarified that there was a negative correlation between the age of children in both cryotherapy and aromatherapy group and behavioral distress score before, during and after needle insertion. This result can be explained that mean age of children in both groups was nearly equal as mentioned in the results before and also as child age increased, they displayed more verbal expressions rather than behavioral signs. **Madadi (2017)** were consistent with these findings and stated in that there was no significant relationship between age of children as one of demographic characteristics of children and pain distress score of AVF puncture⁽²⁶⁾.

In addition, **Bagheriyan (2013)** reached the same result and notified that there was a negative correlation between age of children and their behavioral pain distress scores⁽²⁷⁾. On the other hand, **Czub and piscorz (2018)** were inconsistent with the present result because their study results revealed that the age of children did not correlate in a significant way with the level of experienced pain and the level of distress⁽²⁸⁾.

The present study indicated that there was no significant correlation between Wong Baker faces or behavioral distress scores and sociodemographic variables in both groups. This result in the same direction with **John (2019)** who mentioned that there was no significant relationship between the pain score and variables such as

gender, duration of dialysis and fistula duration⁽²⁹⁾. Also, **Shivcharan (2016)** who proved that there was no significant correlation between AVF puncture pain scores and demographic variables such as sex, the duration of arteriovenous fistula use⁽³⁰⁾. Contrary to the results of **Bartley and Fillingim (2013)** were against the results of the present study as they mentioned that the prevalence of pain was higher among females than males and females reported greater pain after invasive procedures than males⁽³¹⁾.

VI. Conclusion

Based on the findings of the present study, it can be concluded that both cryotherapy and aromatherapy had a positive effect on reduction of AVF puncture pain for children undergoing HD but cryotherapy was more effective in pain reduction than aromatherapy. Both cryotherapy and aromatherapy techniques had a positive effect in decreasing physiological signs and behavioral distress that associated with AVF puncture.

Recommendations

Based on the findings of the present study, **the following recommendations are suggested:**

1. Educational training programs should be conducted for dialysis nursing staff about the application of cryotherapy and aromatherapy and its effect on minimizing AVF puncture pain.
2. Application of ice massage and lavender inhalation should be endorsed as a part of the routine care for hemodialysis children to reduce AVF puncture pain.
3. Cryotherapy and aromatherapy as non pharmacological method for AVF puncture pain management can be included into the curriculum of graduates and post graduates students of faculty of nursing.
4. Hospital managers are encouraged to include cryotherapy and aromatherapy techniques in the training program for dialysis nurses and recommended to be included in the hospital protocol for management of AVF puncture pain.

References

- [1]. Ebrahim A., Hassan M., Mohamed N. Nurses' knowledge and practice regarding care for the patients during hemodialysis. *Medical Journal*. 2016; 84(1): 1135-41.
- [2]. Nagwa A., Taghreed K, Jaklein R. Effect of self-care model intervention on quality of life of children undergoing hemodialysis. *Research and Review Health Care Journal*. 2018; 2(2): 1-9.
- [3]. Clave R., Boucekine M, Ranchin B. Quality of life in adolescents with chronic kidney disease who initiate hemodialysis treatment. *BMC Nephrology*. 2019; 20(2): 1-10.
- [4]. Aghajanloo A, Ghafourifard M, Haririan H. Comparison of the effects of cryotherapy on reducing the pain of arteriovenous fistula cannulation among hemodialysis patients. *Journal of Nursing and Midwifery Sciences*. 2016; 3(1): 59-65.
- [5]. Hinkle J, & Cheever K. Brunner & Suddarth's Textbook of Medical Surgical Nursing. 13th ed., Philadelphia: Lippincott William Wolters Kluwer Co., 2014; 1589-93.
- [6]. Jain J. Handbook of Pain management. 1st ed., Newdelhi: Jaypee Brothers Medical publisher Co., 2018; ch.3: 18-50.
- [7]. Pointon M, Duffiie D, Canon J. Cold application for neuromuscular recovery following intense lower body exercise. *European Journal Applying Physiology*. 2011; 111(12): 2977-86.
- [8]. Nasiri A and Mahmodi M . Aromatherapy massage with lavender essential oil and the prevention of disability in ADL in patients with osteoarthritis of the knee. *Complement Therapies in Clinical Practice*. 2018; 30(5): 116-21.
- [9]. Nesami M, Shorofi S, Nikkhah A., et al. The effects of aromatherapy with lavender essential oil on fatigue levels in hemodialysis patients. *Complementary Therapies in Clinical Practice*. 2016; 22(2): 33-5.
- [10]. Wong D and Baker C. Pain in children: comparison of assessment scales. *Pediatric Nursing Journal*. 1988; 14 (1): 9-17.
- [11]. Elliot S, Jay M, Woody P. An observational scale for measuring children's distress during medical procedures. *Journal of Pediatric Psychology*. 1987; 12(4): 543-51.
- [12]. Dawson B and Trapp R: Reading the medical literature: Basic & Clinical Biostatistics. New York. 3rd ed: McGraw – Hill Co., 2001 Ch. 7-9; 161-218 and Ch. 13; 305-14.
- [13]. Nazari M, kamrani F, sahebalzamani M, Rezaamin G. on the investigation of the effect of aromatherapy on pain after orthopedic surgery. *Acta Medica Mediterranea*. 2016; 32(1): 1513.
- [14]. Canbulat N., Ayban F, Inal S. Effectiveness of external cold and vibration for procedural pain relief during peripheral intravenous cannulation in pediatric patients. *Pain Management Nursing*. 2015; 16(5): 33-9.
- [15]. Elsayed R, Ouda W, Rabee B. Effect of cryotherapy on pain intensity at puncture sites of arteriovenous fistula for children undergoing hemodialysis therapy. Doctoral thesis published on research gate. Benha Univeristy. 2017.
- [16]. Al Amer H, Dator W, Abunab H . Cryotherapy intervention in relieving arteriovenous fistula cannulation-related pain among hemodialysis patients at the King Khalid Hospital. *Saudi Journal of Kidney Diseases and Transplantation*. 2017; 28(5): 1050-56.
- [17]. Waterhouse M, Liu D, Wang V. Cryotherapeutic topical analgesics for pediatric intravenous catheter placement: ice versus vapocoolant spray. *Pediatric Emergency Care*. 2013; 29(1): 8-12.
- [18]. Patidar V. Effectiveness of cryotherapy on pain during arteriovenous fistula puncture among hemodialysis patients. *Journal of laboratory physicians*. 2015; 1(1): 11-5.
- [19]. Shanmugam A, Sundar S, Gowri P. Assess the effectiveness of cryotherapy on arteriovenous fistula puncture site pain among Patients on hemodialysis. *International Journal of Pharmacological and Biological Sciences*. 2017; 8(3): 69-76.
- [20]. Fareed M, Abd El-Hay A, El-Shikh A. Cutaneous stimulation: its effect on pain relieving among hemodialysis patients. *Journal of Education and Practice*. 2014 ;(5)1: 9-12.
- [21]. Bikmoradi A, Khaleghverdi M, Moradkhani S. Effect of inhalation aromatherapy with lavender essence on pain associated with intravenous catheter insertion in preschool children. *Complementary Therapies in Clinical Practice*. 2017; 28 (1): 85-91.
- [22]. Taşana E, Ovayolu O, Ovayolu N. The effect of diluted lavender oil inhalation on pain development during vascular access among patients undergoing hemodialysis. *Complementary Therapies in Clinical Practice*. 2019; 35 (1): 177-182.

- [23]. Ghods A, Abforosh N, Ghorbani R. Effect of topical application of lavender essential oil on the intensity of pain caused by insertion of dialysis needles in hemodialysis patients. *Complementary Therapies in Medicine*. 2015; 23(3): 325-30.
- [24]. Salamati A, Mashouf S, Mojab F. Effects of inhalation of lavender essential oil on open-heart surgery pain. *Iranian Journal of Pharmacological Research*. 2014; 13(4): 1257-61.
- [25]. Lucas C, Bredero H. Does postoperative massage with or without mandarin oil reduce infants' distress after major craniofacial surgery. *Journal of Advanced Nursing*. 2012; 68(8): 1748-57.
- [26]. Madadi Z, Azimian J, Falahatpishe F. Effect of warm footbath on arteriovenous fistula puncture-related pain in dialysis patients. *International Journal of Research in Medical Sciences*. 2017; 5(2):631-5.
- [27]. Bagheriyan S, Borhani F, Abbaszadeh A. Analgesic effect of distraction during venipuncture in children with thalassemia. *Iranian Journal of blood and cancer*. 2013; 5(1): 9-14.
- [28]. Czub M and Piskorz J. Effectiveness of a virtual reality intervention to minimize pediatric stress and pain intensity during venipuncture. *Journal of Special Pediatric Nursing*. 2018; 23(1): 2201.
- [29]. John T., Kanda K, Mandal D. Effect of cryotherapy on arteriovenous fistula puncture related pain among hemodialysis patients at Kalkata hospital. *Indian Journal of Applied Research*. 2019; 9(6): 33-5.
- [30]. Shivcharan S, Deshpande J, Borude S. Effectiveness of cartoon movies as distracter on pain among children undergoing vein puncture. *International Journal of Science and Research*. 2016; 5(6): 2241-45.
- [31]. Bartley E and fillingim R. Sex differences in pain: a brief review of clinical and experimental findings. *British Journal of Anesthesia*. 2013; 111(1): 52-8.

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