

## Effectiveness of Cryotherapy Related Pain Management among Patients Undergoing Hemodialysis at the Site of Arteriovenous Fistula Puncture

Mariam Sabry Shehab

Medical Surgical Nursing, Faculty of Nursing, Port Said University, Port Said, Egypt

**Abstract:** Patients undergoing hemodialysis are frequently exposed to pain from approximately 302 punctures per year to their arteriovenous fistula (AVF) site. Relieving their pain sensation improves their acceptance of the procedure and consequently improves their quality of life. Therefore, the study aimed to investigate effectiveness of cryotherapy related pain management among patients undergoing hemodialysis at the site of arteriovenous fistula puncture. This study was conducted at hemodialysis unit at Alazhar University Hospital at new Damietta city. All available patients undergoing hemodialysis therapy through their arteriovenous fistula (AVF) over 6 months' period about (60) patients. Tools of data collection included a structured interviewing questionnaire, numerical pain rating scale, behavior pain scale and physiological parameters measurement. Results showed highly statistically significant differences between mean score in all vital signs during AVF puncture pre and post cryotherapy. *Conclusion:* cryotherapy was effective on decreasing pain intensity among patients undergoing hemodialysis at puncture sites of arteriovenous fistula. *Recommendation:* Conduction of educational courses about the application of cryotherapy and its effect on reducing the pain should be done for nursing staff.

**Key words:** Cryotherapy • Pain • Patients • Hemodialysis • Arteriovenous fistula

### INTRODUCTION

Cryotherapy is cold application done with ice cubes wrapped in a glove on the web between the thumb and index finger of the hand not having Arterio Venous Fistula (contralateral arm) started 6 minutes before the puncturing procedure and continued 2 minutes after puncture [1].

Arteriovenous fistula is a surgically created connection of a vein and artery usually in the forearm or upper arm, to create an access to the vascular system for hemodialysis as a treatment of chronic renal failure [2].

Hemodialysis is the most frequently used renal replacement therapy. Arteriovenous is made for vascular access in hemodialysis patients [3]. Hemodialysis patients are frequently experience pain, which is caused by approximately 320 punctures inserted in their AVF (arteriovenous fistula) each year. Moreover, large-gauge needles are normally inserted into the AVF in order to preserve the extracorporeal rate of blood flow at 300 ml/min, which could dramatically increase pain intensity [4].

Puncturing of AVF causes pain, therefore local anesthesia is not used because it made complications such as, sensation of burn, scaring and infection. So decreasing patient's pain improve their quality of life and increase their acceptance to the application of cryotherapy [5].

Pain reliving is a basic need and right of all patients, effective pain management requires health professionals, including nurses, is willing to try a number of interventions to achieve optimal results. Methods of reducing pain are grouped into two categories, non-pharmacologic and pharmacologic [6]. Assessment and management of pain are considered as the nursing priority and one of the important aspects of clinical nursing. Therefore, the need to find the new agents with maximum effect and minimal side effects, which accepted by all patients, is felt [7].

Cryotherapy is one of the cutaneous stimulation methods. It is a cheap and simple method that takes an important place among non-pharmaceutical treatments for pain control. For long centuries, use of cooling or Cryotherapy, known as a non-pharmacological technique

for relieving pain. It decrease the velocity of nerve conduction in A- and C-delta fibers, because it reduce the temperature over the inflamed and painful/ area of the skin then transmission of pain signals slowing after that. It is easy, noninvasive, safe and an inexpensive nursing intervention that advocated to minimize patient's pain [7].

**Significance of the Study:** According to WHO (World Health Organization), worldwide the number of receiving renal replacement therapy is estimated at more than 1.4 million with incidence growing by approximately 8% annually. Arteriovenous fistula has a much better access patency and survival than do venous catheters or graft. In CKD (chronic kidney disease), 90.6% population had an AV fistula and 9.4% had an AV graft. During hemodialysis patient may experience some of the related complaints are puncturing pain, muscle cramps, itching, sleep problem and infection. The needles used are 14 to 16 gauges and inserted into the fistula or graft to obtain vascular access. The insertion of large bore needle in to arteriovenous fistula causes significant pain [8]. So it is important to make more studies about various successful methods to relieve pain such as cryotherapy as a non-pharmacological pain management.

**Aim of the Study:** The aim of this study was to evaluate the effect of cryotherapy on managing pain among patients undergoing hemodialysis at the site of arteriovenous fistula puncture.

**Research Hypothesis:** There would be a significant reduction in pain intensity after applying cryotherapy among patients undergoing hemodialysis at the site of arteriovenous fistula puncture.

## MATERIALS AND METHODS

**Technical Design:** A quasi -experimental research design was used.

**Settings:** This study was conducted at hemodialysis unit at Alazhar University Hospital at new Damietta city.

**Subjects:** Study subjects (60) included all available patients undergoing hemodialysis therapy through their arteriovenous fistula (AVF) over 6 months period in the previously mentioned setting. All patients were selected according to the following criteria.

**Inclusion Criteria:** Patients aged 20-90 years, no interventions done when exposing to needle puncture to decrease pain during puncture, arteriovenous fistula skin are healthy (no signs of inflammation or infection).

**Exclusion Criteria:** Patients have sensitivity to cold test that was done by researcher or patients have any contraindication for cold application e.g. vascular diseases. Patients on analgesic medications or having radiation injuries, peripheral vascular diseases, diabetic neuropathy, connective tissue disorders, alternated level of consciousness and suffering from pain of other origin than AVF were excluded from the study.

### Tools of the Study

**Tool (I) Structured Interviews:** To collect data from the patients a structured interview form was designed. It included the personnel characteristics of the studied patients as age, sex level of education and living areas. The history of disease, including disease duration and comorbidities, hemodialysis frequency and duration and AVF status.

**Tool (II) Numerical Pain Rating Scale [9]:** It is one of the standardized tools for quantifying pain intensity, which consists of a scale with values ranging from 0-10. Total pain tools score was 10. Mean score for the different levels of pain was calculated as follows: - no pain (zero), mild pain (1-3), moderate pain (4-6) and severe pain (8-10).

**Tool (III) Observed Pain Behavior Rating Scale:** The Observed Pain Behavior Rating Scale reflect an objective pain assessment according to Behavior Checklist Scale. The scale composed of 8 behaviors that can be observed (crying, screaming pain verbalization, anxiety verbalization, verbal stalling, tension of muscles, physical resistance, restraint usage). Behaviors degree is 5-point accordind to Likert scale, start from one to five [(“very mild”) to (“extremely intense”)]. It also contain psychometric properties [10].

**Physiological Assessment:** Assessment the physiological parameters, which can changed by pain, were done. These parameters included rate of respiration, pulse rate, blood pressures and saturation of oxygen level. Assessment done using standardized methods.

**Administrative Design:** Prior to data collection, a written permission to carry out the study was obtained from the director of hemodialysis unit after submitting an official letter from the dean of the faculty of nursing at Port Said University explaining the purpose of the study and methods of data collection.

### Operational Design

**Preparatory Phase:** The researcher reviewed the local and international related literature covering various aspects of the study problem using books, articles, international periodical and magazines to prepare necessary tools for validity purposes.

**Validity and Reliability:** All tools were tested for content validity by 7 experts in nursing fields. Then pain scales were tested for reliability by using Cronbach's Alpha reliability analysis.

**Ethical Considerations:** All participants and their parents were informed about the aim of study, its benefits and data collection tools in order to obtain their acceptance to participate. The researcher informed them that the participation in the study is voluntary; they have the right to withdraw from the study at any time, without giving any reason and that their responses would be held confidentially. An oral consent for acceptance for participation was obtained from the patients.

**Pilot Study:** Pilot study was carried out on five patients to check the clarity, applicability and feasibility of tools and make the necessary modification. No modifications were done to the tools. Therefore, the sample of the pilot study was included in the total study sample.

**Fieldwork:** Collection of data took about 8 months starting from 1 January 2018 to the end of August 2018. The researcher visited the hemodialysis units at Alazhar University Hospital two days weekly (Sunday & Thursday) from 8 A.M to 11 A.M to collect the data by using previous tools. The researcher interviewed patients individually and explained the nature and purpose of the study in order to be sure that every statement was understood and clear to every patient; each interview took from 15 to 30 minutes.

- Data collection was initiated by assessing socio demographic data, medical data and arteriovenous fistula site through interviewing each patient

individually using tool I. In addition, the researcher attended with patient during carrying out AVF puncture to assess patient response to pain

- During the first session only a usual needle punctures were done for all patient by nurse of the dialysis unit as hospital routine without any intervention and the researcher assessed pain behavior during the AVF puncture to determine the objective pain scoring using tool II. Patients were asked after the AVF puncture to tick on the numeric pain rating scale to indicate how strong their pain during AVF puncture. Physiological measures of pain such as pulse, O<sub>2</sub> saturation, respiration and blood pressure (systolic and diastolic) were assessed for each patient during AVF puncture.
- In session two, the researcher did sensitivity test to each patient in the contralateral site to AVF to detect sensitivity to ice. The used ice was 2-3cm ice of frozen distal water inside plastic bag.
- Ice massage was done by the researcher (with ice of frozen distal water inside plastic bag) by slow circular motion massage with interrupted periods to prevent skin injury. The procedure was started five minutes before venipuncture and continued throughout the puncturing procedure (approximately two minutes) or until patient feel skin numbness (when necessary replacing the frozen ice bag occurred if ice melting start). After that the puncture sites of the AV fistula was sterilized as protocol of sterilization, which was used in the unit. The researcher assessed the objective pain behavior during the AVF puncture to determine the objective pain scoring using tools II& III.
- Physiological measures of pain were assessed for each patient during AV F puncture with cryotherapy.
- Each patient was reviewed with the researcher how to tick on the numeric pain rating scale after puncture with cryotherapy to indicate how strong their pain during AVF puncture using tool III.

**Statistical Design:** Data was coded and transformed into specially designed form to be suitable for computer entry process. Data was entered and analyzed by using SPSS (Statistical Package for Social Science) version 20. The collected data were organized, categorized and analyzed, using frequencies, percentage, mean scores, standard deviation and chi-square test. Data were presented in form of tables.

**RESULTS**

The highest ratio of the study group was aged more than 60 and the lowest was between 20 and 30 years. While the mean age of the study group was 48.5±1.5 years. More than half of them were female (55%). About (31.7%) had preparatory education. Two third of the study group were lived in urban (63.3%) (Table 1).

As regard, duration of disease about (43.3%) had kidney disease more than 10 years. The majority of patients had other chronic disease (78.3). Most of the study population had two-dialysis session per week. More than half of patients had abnormal signs at the site of AVF. Sensitivity appear for the majority after 10 minutes from application of cryotherapy about (78.3%), while the cryotherapy duration ranged 2-15 minutes (Table 2).

According to pain rating scale(Wong baker faces ) there was a statistically significant decrease was observed in all items especially in self-control, pain verbalized, anxiety verbalized and verbal stalling (Table 3).

According to numerical pain, rating scale the majority of the study group had between moderate and sever pain pre intervention. While post intervention more than half of the study group (73.3) had no pain (Table 4).

All physiological parameters showed improvement after cryotherapy. The most prominent improvement was in respiration and pulse compared between pre and post application of cryotherapy (Table 5).

Table 1: Distribution of the studied patients according to their characteristics (n=60)

| Item              | Frequency (n) | Percentage (%) |
|-------------------|---------------|----------------|
| Age / years       |               |                |
| 20 < 30           | 5             | 8.3            |
| 30 < 40           | 17            | 28.3           |
| 40 < 50           | 13            | 21.7           |
| 50 < 60           | 6             | 10.0           |
| <60               | 19            | 31.7           |
| Mean ±SD          | 48.5 ± 1.5    |                |
| Gender            |               |                |
| Male              | 27            | 45.0           |
| Female            | 33            | 55.0           |
| Educational level |               |                |
| Illiterate        | 10            | 16.7           |
| Primary           | 17            | 28.3           |
| Preparatory       | 19            | 31.7           |
| Secondary         | 12            | 20.0           |
| University        | 2             | 3.3            |
| Residence         |               |                |
| Rural             | 22            | 36.7           |
| Urban             | 38            | 63.3           |

Table 2: Distribution of the studied patients according to their clinical data (n=60)

| Item                               | N  | %    |
|------------------------------------|----|------|
| Duration of disease/ years         |    |      |
| Less than 5                        | 9  | 15.0 |
| 5-10                               | 25 | 41.7 |
| More than 10                       | 26 | 43.3 |
| History of chronic diseases        |    |      |
| Yes                                | 47 | 78.3 |
| No                                 | 13 | 21.7 |
| Duration of dialysis               |    |      |
| < 1 year                           | 13 | 21.7 |
| ≥ 1 year                           | 47 | 78.3 |
| Number of dialysis / week          |    |      |
| Two times                          | 45 | 75.0 |
| Three times                        | 15 | 25.0 |
| Place of fistula                   |    |      |
| right arm                          | 34 | 56.7 |
| left arm                           | 26 | 43.3 |
| Duration of fistula                |    |      |
| < 1 year                           | 13 | 21.7 |
| ≥ 1 year                           | 47 | 78.3 |
| Side effects of fistula            |    |      |
| Yes                                | 52 | 86.7 |
| No                                 | 8  | 13.3 |
| Period of cryotherapy/ minutes     |    |      |
| 2 - 10                             | 36 | 60.0 |
| > 10                               | 24 | 40.0 |
| Occurrence of sensitivity/ minutes |    |      |
| 2 - 10                             | 13 | 21.7 |
| > 10                               | 47 | 78.3 |

Table 3: Distribution of the studied patients according to their behavior toward pain (Wong baker faces pain rating scale) (n=60)

| Item                             | Pre |      | Post |      |
|----------------------------------|-----|------|------|------|
|                                  | N   | %    | N    | %    |
| Behavior of patients toward pain |     |      |      |      |
| Verbalization of pain            | 22  | 36.7 | 11   | 18.3 |
| Verbalization of anxiety         | 7   | 11.7 | -    | --   |
| Stalling verbally                | 20  | 33.3 | 3    | 5.0  |
| Tension of muscles               | 5   | 8.3  | 1    | 1.7  |
| Resistance physically            | 3   | 5.0  | 1    | 1.7  |
| Self – control                   | 3   | 5.0  | 44   | 73.3 |

Table 4: Distribution of the studied patients according to their pre & post numerical pain rating scale (n=60)

| Degree of pain | Pre numerical pain scale |      | Post numerical pain scale |      |
|----------------|--------------------------|------|---------------------------|------|
|                | N                        | %    | n                         | %    |
| No pain        | 3                        | 5.0  | 44                        | 73.3 |
| Mild pain      | 11                       | 18.3 | 16                        | 26.7 |
| Moderate pain  | 22                       | 36.7 | -                         | --   |
| Severe pain    | 24                       | 40.0 | -                         | --   |

Table 5: Distribution of the studied patients according to their pre & post vital signs and saturation level (n=60)

| Vital signs                     | Pre value |      | Post value |      |
|---------------------------------|-----------|------|------------|------|
|                                 | N         | %    | N          | %    |
| <b>Respiration</b>              |           |      |            |      |
| Hypopnea                        | 0         | 0.0  | 0          | 0.0  |
| Normal                          | 1         | 1.7  | 45         | 75.0 |
| Tachypnea                       | 59        | 98.3 | 15         | 25.0 |
| <b>Pulse</b>                    |           |      |            |      |
| Bradycardia                     | 0         | 0.0  | 0          | 0.0  |
| Normal                          | 4         | 6.7  | 34         | 56.7 |
| Tachycardia                     | 56        | 93.3 | 26         | 43.3 |
| <b>Saturation</b>               |           |      |            |      |
| Low rate                        | 34        | 56.7 | 13         | 21.7 |
| Normal                          | 26        | 43.3 | 47         | 78.3 |
| High                            | 0         | 0.0  | 0          | 0.0  |
| <b>Systolic blood pressure</b>  |           |      |            |      |
| Low                             | 25        | 41.7 | 0          | 0.0  |
| Normal                          | 9         | 15.0 | 52         | 86.7 |
| High                            | 26        | 43.3 | 8          | 13.3 |
| <b>Diastolic blood pressure</b> |           |      |            |      |
| Low                             | 25        | 41.7 | 0          | 0.0  |
| Normal                          | 9         | 15.0 | 52         | 86.7 |
| High                            | 26        | 43.3 | 8          | 13.3 |

Table 6: Relation between pre and post vital signs pain scale (n=60)

| Item                            | Mean  | SD   | T test | P    |
|---------------------------------|-------|------|--------|------|
| <b>Respiration</b>              |       |      |        |      |
| Before                          | 23.33 | 1.55 | 23.77  | .000 |
| After                           | 17.73 | 1.07 |        |      |
| <b>Pulse</b>                    |       |      |        |      |
| Before                          | 96.25 | 2.43 | 19.33  | .000 |
| After                           | 77.0  | 6.48 |        |      |
| <b>Systolic blood pressure</b>  |       |      |        |      |
| Before                          | 98.88 | 2.57 | 22.34  | .000 |
| After                           | 1.187 | 5.81 |        |      |
| <b>Diastolic blood pressure</b> |       |      |        |      |
| Before                          | 58.70 | 2.55 | 20.72  | .000 |
| After                           | 72.03 | 3.99 |        |      |
| <b>Saturation</b>               |       |      |        |      |
| Before                          | 95.03 | .68  | 23.89  | .000 |
| After                           | 97.90 | .68  |        |      |
| <b>Behavioral pain scale</b>    |       |      |        |      |
| Before                          | 7.50  | .72  | 12.85  | .000 |
| After                           | 4.43  | 1.47 |        |      |
| <b>Numerical pain scale</b>     |       |      |        |      |
| Before                          | 3.11  | .88  | 20.21  | .000 |
| After                           | 1.26  | .44  |        |      |

Table 6 shows comparison in mean score of vital signs, oxygen saturation, behavior pain scale and numerical pain scale pre and post cryotherapy (t =23.77, 19.33, 22.34, 20.72, 23.89, 12.85, 20.2, 1 respectively). There were highly statistically significant differences between mean score of all items during AVF puncture pre and post cryotherapy.

## DISCUSSION

Cryotherapy, known as a non-pharmacological technique for relieving pain. It decrease the velocity of nerve conduction in A- and C-delta fibers, because it reduce the temperature over the inflamed and painful/ area of the skin then transmission of pain signals slowing after that. It is easy to learn and can be used to relieve various symptoms in various patient care settings. It is a natural treatment modality, simple, non-invasive and has absolutely no side effects [11]. Therefore, this study aim was to evaluate effectiveness of cryotherapy related pain management among patients undergoing hemodialysis at the site of arteriovenous fistula puncture.

More than half of them were female (55%). This result disagrees with the result of study by Al Amer *et al.* [12] who found that more than half of the respondents (n = 36, 59%) were male.

As regard, duration of disease, about (43.3%) had kidney disease more than 10 years. The majority of patients had other chronic disease (78.3). Most of the study population had two-dialysis sessions per week. More than half of patients had abnormal signs at the site of AVF. Sensitivity appeared for the majority after 10 minutes from application of cryotherapy about (78.3%), while the cryotherapy duration ranged 2-15 minutes. These findings are not matched with those obtained by Attia & Hassan [13].

On the other hand, in the same line with John *et al.* [14] study , majority of the patients belonging to the age group of 40-59 years, with secondary level education, Maximum number of patients suffered from CKD between 21-40 months and had the duration of A.V.Fistula access for 6-10 months taking dialysis twice a week.

In Wong baker faces pain rating scale a statistically significant improvements was observed in subjective and objective items. The study results are in line with Sabithia *et al.* [15] who also found that the objective and subjective pain scores were signicantly reduced within the experimental group with the application of cryotherapy. Also, agree with Alhani *et al.* [16] who showed that using distraction program lead to decrease pain resulted from venipuncture among HD adolescents Moreover Celik *et al.* [4] stated that pain scoring decreased signicantly in cryotherapy study group with using a supercial cooling.

According to numerical pain, rating scale the majority of the study group had between moderate and sever pain pre intervention. While post intervention more than half of the study group (73.3) had no pain. These results agree with Al-Amer *et al.* [12], who stated, the pain score

among the experimental group was found to be significantly reduced after using cryotherapy ( $P < 0.001$ ). Also in the same line, with research conducted by Patidar [1] who found an average objective assessment of pain before cryotherapy was 3.71, which decreased to 2.66 after cryotherapy. While average numerical rating scale score before cryotherapy was 4.01, which decreased to 2.98 after cryotherapy. This indicates that the cryotherapy is significantly effective in improving the level of pain among patient undergoing hemodialysis with AV fistula.

All physiological parameters showed improvement after cryotherapy. The most prominent improvement was in respiration and pulse with compared between pre and post application of cryotherapy. These findings agree with Attia & Hassan [13]. In addition, with another recent Egyptian study by Fathalla & Bayoumi [17] who found those children in the buzzy and cryotherapy groups had lower mean heart and respiratory rates during and after blood specimen collection.

There were highly statistically significant relation between pre and posttest in all vital signs (respiration, pulse, systolic & diastolic blood pressure, oxygen saturation, numerical pain scale and behavior pain scale) ( $p$  value at point 0.001). This reflects the effectiveness of the study and its importance. These results agree with Lijiya and Diana [3], effectiveness of cryotherapy on arteriovenous fistula puncture related pain among hemodialysis patients, who found, a significant difference between the pre-test and post- test behavioral response scores and pain scores in the experimental group ( $F_2, 72 = 3.15, p < 0.05$ ).

Cryotherapy is a non-pharmacological method and connected too many benefits including cost and accessibility to its use. The efficiency of cryotherapy in decreasing pain has been proven in various studies [18-23]. Furthermore, cryotherapy has clinical implications as easily implementation by nurses to manage the pain caused by the AVF puncture within a relatively short time.

### CONCLUSIONS

Based on the results of current study, it was concluded that, cryotherapy was effective on decreasing pain intensity among patients undergoing hemodialysis at puncture sites of arteriovenous fistula. In addition, there was a statistical significant difference in patients' physiological parameters pre and post cryotherapy.

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

- Cryotherapy can be used during different painful procedures
- Replicated the same study should be done on a large sample size with newly patients to compare the results and show the effectiveness.
- Conduction of educational courses about the application of cryotherapy and its effect on reducing the pain should be for nursing staff.
- Advice health care providers especially, hemodialysis nurses about the importance to accept and assess patient pain correctly, especially during AVF procedures, so nurses need to increase their knowledge and responsibility.
- Most units especially, hemodialysis should involve protocol for cryotherapy for pain management in the routine care for patients according to the case.

### REFERENCES

1. Patidar, V., 2015. Effectiveness of Cryotherapy on Pain during Arteriovenous Fistula Puncture among Hemodialysis Patients. *J. Lab. and Life Scs.*, 1(1): e25-e30.
2. Brunner and Suddarth's, 2014. *Text Book of Medical Surgical Nursing*, 13<sup>th</sup> edition, Lippincott Williams Wilkins, New Delhi, pp: e1548 -e1551.
3. Lijiya, J. and L. Diana, 2015. Effectiveness of Cryotherapy on Arteriovenous Fistula Puncture related Pain among Hemodialysis Patients in Selected Hospitals, Mangalore. *International Journal of Advances in Nursing Management*, 3(3): e267-e272.
4. Çelik, G., O. Özbek, M. Yılmaz, I. Duman, S. Özbek and S. Apiliogullari, 2011. Vapocoolant spray vs. lidocaine/prilocaine cream for reducing the pain of venipuncture in hemodialysis patients: a randomized, placebo-controlled, crossover study. *Int. J. Med. Sci.*, 8(7): 623-e27.
5. Santa, D.E., 2015. Effectiveness of cryotherapy on pain during AV fistula puncture pain among hemodialysis patients, *Asian Academic Research Journal of Multidisciplinary*, 2(4): e24.
6. Alalo, F.M.A., A.E. Ahmad and H.M.N. El-Sayed, 2016. Pain intensity after an ice pack application prior to venipuncture among school- age children: an experimental study, *Journal of Education and Practice*, (7)36: e33.

7. Naji, S., E. Davtalab and S.H. Shahidi, 2016. Comparing the effects of Valsalva maneuver and ice massage at Hoku point methods on pain intensity within the needle insertion to the arteriovenous fistula (AVF) for patients undergoing hemodialysis in the selected hospitals. *Int. J. Med. Res. Health Sci.*, 5(5): e101-e107.
8. Varma, P., 2015. Prevalence of Chronic Kidney Disease in India. Where are we heading. *Indian Journal of Nephrology*, 25(3): e133-e153.
9. McCaffery, M. and A. Beebe, 1993. *Pain: Clinical Manual for Nursing Practice*. V.V. Mosby Company, Baltimore.
10. Blount, R.L. and K.A. Loiselle, 2009. Behavioral assessment of pediatric pain. *Pain Res Manage.*, 14(1): e47-e52.
11. Shali, G.S., 2012. Outcome of cryotherapy on arteriovenous fistula puncture pain among patients on hemodialysis in selected hospitals at Chennai. Published Master Thesis, Faculty of Medicine. Tamil Nadu Medical University Chennai.
12. Al-Amer, H., W. Dator, H. Abunab and M. Mari, 2017. Cryotherapy Intervention in Relieving Arteriovenous Fistula Cannulation-Related Pain among Hemodialysis Patients at the King Khalid Hospital, Tabuk, Kingdom of Saudi Arabia. *Saudi J. Kidney Dis Transplant.*, 28(5): e1050-e1056.
13. Attia, A.A.M. and A.M. Hassan, 2017. Effect of cryotherapy on pain management at the puncture site of arteriovenous fistula among children undergoing hemodialysis. *International Journal of Nursing Sciences*, 4: e46-e51.
14. John, T., K. Kundu and D. Mandal, 2019. A study to assess the effect of cryotherapy on arteriovenous (AV) fistula puncture related pain among hemodialysis patients at selected hospital in Kolkata, west Bengal. *Indian Journal of Applied Research*, 9(6): e33-e36.
15. Sabitha, P.B., D.C. Khakha, S. Mahajan, S. Gupta, M. Agarwal and S.L. Yadhav, 2008. Effect of cryotherapy on arteriovenous stula puncture related pain in hemodialysis patients. *Indian Journal of Nephrology*, 18(4): e87-e90.
16. Alhani, F., H. Shad, M. Anoosheh and E. Hajizadeh, 2010. The Effect of Programmed Distraction on the Pain Caused by Venipuncture among Adolescents on Hemodialysis. *Pain Management Nursing*, 11(2): e85-e9.
17. Fathalla, A.A. and M.H. Bayoumi, 2018. Effect of Thermomechanical Stimulation (Buzzy R) and Cryotherapy on Children Pain, Anxiety and Satisfaction during Blood Specimen Collection. *Journal of Health, Medicine and Nursing*, 57: e12-e25.
18. Hassan, A., M.M. Darwish, G.A. El-Samman and F.I. Fadel, 2012. The impact of cryotherapy on pain intensity at puncture sites of arteriovenous fistula among children undergoing hemodialysis. *J. Am.*, 8: e1490-e500.
19. El-Said R., W. Ouda, F. Mahmoud and B. Abd El-Sadek, 2017. Effect of Cryotherapy on Pain Intensity at Puncture Sites of Arteriovenous Fistula for Children Undergoing Hemodialysis Therapy. Doctorate degree. Benha University. Faculty of Nursing.
20. Gad, G., S. Ebrahim, G. Ahmed, A. Hammad, N. Hamdy and R. Eid, 2019. Applying Cryotherapy and Balloon Inflation Technique to Reduce Pain of Arteriovenous Fistula Cannulation among Children Undergoing Hemodialysis. *International Journal of Nursing Didactics*, 9(5): e29-e35.
21. Matheson, L., M. Stephenson and B. Huber, 2014. Reducing Pain Associated with Arterial Punctures for Blood Gas Analysis. *Pain Manag. Nurs.*, 15(3): e619-e624.
22. Mansy, G.E., S.R. Zaher, O.G. Waziry and E.G. Eshak, 2010. The effect of two nonpharmacologic pain management methods on pain-associated with intramuscular injection among rheumatic children. *Alexand Pediat*, 24(1): e135-e42.
23. Baxter, A.L., L.L. Cohen, H.L. McElvery, M.L. Lawson and C.L. Von Baeyer, 2011. An integration of vibration and cold relieves venipuncture pain in a pediatric emergency department. *Pediatr Emerg Care*, 27(12): e1151-e6.