

The impact of cryotherapy on pain intensity at puncture sites of arteriovenous fistula among children undergoing hemodialysis

Asmaa Mahfouz Hassan¹, Mirret Mohamed Darwish¹; Gehan Ahmed El-Samman¹ and Fatina Ibrahim Fadel²

¹Pediatric Nursing, Faculty of Nursing, Cairo University, Cairo, Egypt

²Pediatric Nephrology, Faculty of Medicine, Cairo University, Cairo, Egypt

asma_mahfouz@hotmail.com

Abstract: Pain inflicted by the insertion of large cannulae into the arteriovenous fistula is a significant cause of concern for both children and adults on regular hemodialysis. Cryotherapy as a non pharmacological pain management is a complementary therapy has the advantage of being effective, less cost, easy to provide and safe. The aim of the study was to investigate the impact of cryotherapy on pain intensity at puncture sites of arteriovenous fistula among children undergoing hemodialysis. A total sample of 40 children undergoing hemodialysis using arteriovenous fistula was selected during six months from two hemodialysis Units, Cairo University. Quasi-experimental design (pre-post test) was chosen to conduct this study. Two tools utilized for the study: structure interview questionnaire schedule sheet and subjective pain assessment tool (Wong-Baker faces pain rating scale). The results of the study showed that more than half of children were females. The majority of children did not prefer change puncture site to decrease pain sensation. The mean of Wong-Baker faces pain score during artery needle puncture reduced in the study group in the day 3 and 4 (0.82 ± 0.84 , 0.75 ± 0.80 respectively) than the control group in the day 1 and 2 (1.57 ± 1.35 , 1.60 ± 1.25 respectively). The mean of Wong-Baker faces pain score during vein needle puncture reduced in the study group in the day 3 and 4 (0.97 ± 0.99 , 0.77 ± 1.12 respectively) than the control group in the day 1 and 2 (1.77 ± 1.49 , 1.90 ± 1.21 respectively). The study concluded that cryotherapy is effective in reducing subjective pain scores. The study recommended that hemodialysis units should involve cryotherapy for managing needle puncture pain in the routine care for hemodialysis children.

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1. Introduction:

Chronic illness among children is a serious, ongoing, physical health conditions that cause stress on child and family. The conditions continually or repeatedly threaten to disrupt normal development in physical, emotional, psychological, social, economical, and spiritual aspects. Chronic illnesses among children range from relatively mild ones to severe and life threatening disorders, such as cancer, diabetes mellitus, and chronic renal failure (Theofanidis, 2008, Hockenberry, & Wilson, 2009).

Renal failure (RF) is a condition in which the kidneys cannot concentrate urine, conserve electrolytes, or excrete waste products. Renal failure in children may occur as an acute or chronic condition (Ghai *et al.*, 2009). Technologic advances in the care of children with acute renal failure and chronic renal failure provide several renal replacement therapies (RRT) for maintaining excretory function in acute disease and for prolonged life in those with renal failure, the primary modalities are haemodialysis (HD), peritoneal dialysis (PD), hemofiltration, and transplantation (Ricci, & Kyle, 2009)

Chand *et al.* (2009) emphasized that hemodialysis continues to be the most frequently utilized modality for renal replacement therapy in incident pediatric end stage renal disease. The number of children on hemodialysis exceeded the sum total of those on peritoneal dialysis and those undergoing pre-emptive renal transplantation.

Hemodialysis requires an access for blood removal and return. The blood is removed from one area, port, or needle; passed through an artificial kidney; and returned to the patient. The dialysis machine circulates the blood, removing excess fluids and excess waste products. There are three different types of vascular access for hemodialysis arteriovenous fistula (AVF), arteriovenous graft (AVG), and central venous catheter (CVC) (Votroubek & Tabacco, 2010). The standard schedule of most children undergoing HD are three sessions every week. Each session lasts 3 - 4 hours. Initially, peripheral arteries and veins were cannulated at every dialysis session (Bojakowski & Andziak, 2011).

Patients with end-stage renal disease undergoing hemodialysis are repeatedly exposed to stress and pain from approximately 300 punctures per year to their AVF. Considerable patient discomfort

and stress can be associated with the insertion of large-gauge needles into an AVF. Alleviation of this pain might improve their acceptance of the procedure and thus, their quality of life (Çelik *et al.*, 2011).

Pain is a difficult concept to define, but the working definition used by International Association for the Study of Pain (IASP) (2009) is "an unpleasant sensory and emotional experience associated with actual or potential tissue damage". Children of various developmental ages respond differently to pain and perceive pain in different ways, it is important to review developmental considerations (Kyle, 2008). Nurses must understand how children respond to painful stimuli and what behaviors may be expected based on their developmental level. By understanding these developmental considerations, the nurse can appropriately assess the child's pain and provide effective interventions (Waston, 2008).

Ricci, & Kyle (2009); Timby (2009) listed strategies for pain management to include pharmacological and non-pharmacological interventions. Non-pharmacologic interventions such as behavioral- cognitive strategies such as distraction, relaxation, biofeedback, thought stopping, positive self talk, guided imagery and biophysical interventions such as massage, pressure, transcutaneous electrical nerve stimulation (TENS), and heat and cold application.

According to Moses (2008) cryotherapy defined as a form of therapy consisting in the local or general use of cold. Hughes (2008) clarified that it used for the treatment of pain and/or inflammation by lowering the temperature of the skin over the affected area. Cryotherapy can be applied topically (on the skin surface), percutaneously, or surgically. Cold therapy can be delivered in three basic forms: cold packs, ice massage, or vapocoolant spray.

Ice massage technique produces analgesia when massage is given with a solid piece of ice, either an ice cube or ice lollypop is wrapped with a small towel, leaving one surface free. Ice massage is normally performed in a slow, circular motion over a small area. An area of 10-15 cm² needs to be ice massaged for up to 10 minutes or until numbness is felt and the physiological effects starts to appear (Smyth, 2009; Schilling McCann, 2009). Cryotherapy should not be used on persons who have vascular diseases as Raynaud's syndrome; paroxysmal cryoglobulinaemia; cold haemoglobinuria; unable to respond or cannot feel cold (e.g. a neuropathy; or paralysis of a limb); allergic to cold (develop a rash and blisters to cold) (Hughes, 2008).

Smyth (2009) mentioned that cryotherapy is a common and useful therapeutic modality often used in treating a wide range of conditions. It is easy to apply and if care is taken over cautions and

contraindications it is very safe and patients can be instructed to self treat to manage their conditions independently. Sabitha *et al.* (2008) recommend use cryotherapy prior to venipuncture as an easy and effective intervention for reducing venipuncture-related pain and confirm that cryotherapy is effective in alleviating pain due to arteriovenous fistula puncture in hemodialysis patients and there is a need for adopting alternative therapies such as cryotherapy for effective pain management in hospital settings.

Significance of the Study

Pain inflicted by the insertion of large cannulae into the AVF is a significant cause of concern for both children and adults on regular HD. Although AVF puncturing causes pain, local anesthesia is not frequently used due to concerns of vasoconstriction, burning sensation, scarring, and infection. On average, a patient on maintenance hemodialysis undergoes ten AV fistula punctures a month and would continue to do so throughout their lifetime or until a successful renal transplant (Sabitha *et al.*, 2008).

Nurse as advocates for children, are obligated to minimize the emotional and physical effects of painful procedures, so it was important to nurses make study about various successful methods to control procedural pain such as cryotherapy (cold therapy) as a non pharmacological pain management is expected to become integrated in the modern medical system as it is a complementary therapies (AI-Mutairi *et al.*, 2009).

Aim of the study:

The aim of the current study was to investigate the impact of cryotherapy on pain intensity at puncture sites of arteriovenous fistula among children undergoing hemodialysis.

Research Hypothesis:

Children undergoing hemodialysis who will apply cryotherapy before arteriovenous fistula puncture will have lower Wong-Baker faces pain rating scores than who don't.

2.Subjects and Methods

A quasi-experimental design (pre-post test) was utilized to perform the study. Children included in the study were considered at first time as a control group where no cryotherapy and at second time the same children considered as a study group when cryotherapy were done.

Sample:

A total sample of 40 children undergoing HD using arteriovenous fistula were selected during six months from May to October 2011.

The inclusion criteria were: children with chronic renal failure undergoing HD using AVF, aged 8-18 years, exposing to routine needle puncture without interventions done to decrease pain during,

healthy arteriovenous fistula skin (no signs of inflammation or infection), needle puncture done from first trial. The exclusion criteria were: children taking topical anesthetic preparation before needle puncture, children had allergic to cold applications, or had any contraindication for cold application e.g. vascular diseases as Raynaud's syndrome, neuropathy.

Setting:

This study was conducted in two centers: the Center of Pediatric Nephrology and Transplantation at Monira Children Hospital and the Center of Pediatric dialysis at Specialized Pediatric Hospital (CUSPH) Cairo University.

Tools for Data Collection:

Data pertinent to the study variables were collected by the following tools:

1-Structure interview questionnaire schedule:

It was constructed by the researcher after reviewing the relevant literature. It was covering the following items: sociodemographic characteristics of children, medical history of the disease, data related pain and needle puncture in AVF. The tool used for once.

2- Subjective pain assessment tool (Wong-Baker faces pain rating scale)

It was used twice as pre and post test. It developed by Wong & Baker (1988). It was self report faces scale for acute pain. Six line drawn faces range from no hurt to hurts worst. Face 0 didn't hurt at all, face 2 hurt just a little bit, face 4 hurt a little more, face 6 hurt even more, face 8 hurt a whole lot, face 10 hurt as much as you can imagine, although child didn't have to be crying to have this worst pain (Wong, 2008). Scoring system was used to divide pain into four levels as following: score zero means no pain, scores 1-2 mild pain, scores 4-6 moderate pain, scores 8-10 severe pain.

Validity and Reliability:

Structure interview questionnaire schedule were given to a panel of 5 experts (2 experts in pediatric nursing, 2 experts in pediatric renal dialysis, and one expert in pediatric physical therapy) to obtain the agreement with the scope of items and to examine the extent to which the items reflect the concepts under study. A modification of the tool was done according to the panel judgment on clarity of sentences, appropriateness of content, and sequences of items.

Content validity of Wong-Baker faces pain rating scale was present (Conlon, 2009), the tool was translated to Arabic language to be used and then retranslated to check its accuracy then reliability was done (Cronbach's Alpha 0.70).

Ethical consideration

An official permission from the directors of Pediatric Hospitals and the heads of Center of

Pediatric Nephrology and Transplantation in selected hospitals were taken. A clear and simple explanation about the aim and nature of the study were discussed by the researcher for each child and their parents who fulfilling inclusion criteria, then the written informal consent were obtained to get their acceptance as well as to gain their cooperation. Children and their parents were informed about the confidentiality of data and they have a right to withdrawn from the study at any time without any effect on their routine care they received.

Data Collection Procedure:

Data collections done through six sessions, each session duration was about 20-30 minutes:-

First session: child and parent were interviewed in the waiting room before dialysis session. The researchers fill the interview questionnaire schedule. During interview the researcher explained subjective pain assessment tool (Wong-Baker faces pain rating scale) and trained each child about how to use the tool prior to apply it.

Second session: ice sensitivity test was done by the researcher in the contralateral site to AVF to detect child sensitivity to ice. The used ice was 2-3cm ice of frozen distal water inside plastic bag. Individualized ice bag for each child was used and contained label of child name.

Third and fourth sessions: at first time children were served as a control group where no intervention (no cryotherapy), only a usual needle punctures done by renal nurse of the dialysis unit as it is routine in the selected hospitals. It was applied in the dialysis centers in two consecutive dialysis sessions during the first and second day of the study. After needle puncture each child reviewed with the researcher how to use Wong-Baker faces pain rating scale prior to applying it. Then the child was asked to fulfill Wong-Baker faces pain rating scale as he perceived pain intensity during needle puncture.

Fifth and six sessions: at second time the same children were served as study group where cryotherapy intervention was applied in the dialysis unit in two consecutive dialysis sessions during the third and fourth day of the study. The researcher putting olive oil (one or two drops) over two puncture sites of the AV fistula to reduce danger of ice burn and made ice massage (with 2-3cm ice of a frozen distal water inside plastic bag) by slow circular motion massage with interrupted periods to prevent skin injury. Ice massage done until skin numbness was felt (replacing the frozen ice bag occurred when necessary if ice melting start). Sterilization was done for puncture sites of the AV fistula as usual protocol of sterilization in the center. After puncture each child reviewed with the researcher how to use Wong-Baker faces pain rating scale prior to applying it to rate

actual pain. Then the child was asked to fulfill Wong-Baker faces pain rating scale where child rated the perceived pain intensity which he felt during needle puncture.

Pilot study:

The pilot study was carried out on 10% of the total sample (4 children) to test study tools in terms of its clarity, applicability, time required to fulfill it and accordingly some modifications was done. Those who shared in the pilot study were included in the study sample.

Statistical Analysis:

The collected data were categorized, tabulated, and summarized. Data were computerized and analyzed using appropriate descriptive and inferential statistical tests were used to examine the research hypothesis. Descriptive statistics used in the study were frequencies, percentage, mean, and standard deviation. Chi square, two-sample and paired t-tests, Spearman's and Pearsons correlations were used for inferential statistics as deemed appropriate. A statistical package for the social studies (SPSS) was used for statistical analysis of data. The p -value <0.05 was considered statistically significant.

3. Results

Table (1) indicated that more than half of children (55%) were female. Their ages ranged between 12- <16 and the mean age was 11.72 ± 1.74 years. Regarding to children education, figure (1) illustrated that less than half of children had preparatory (40%), while the minority didn't complete primary education (10%). It was found that less than half of children (42.5%) were the first or second child in the family and they had 3-4 siblings. In relation to residence more than half of children (52.5%) were from rural regions.

In relation to medical history of children, figure (2) revealed that, concerning diseases associated with dialysis, more than one third of children (37.5%) had hepatitis, followed by more than one quarter of children had hypertension and cardiac disease (32.5%, 30% respectively).

As regard number of dialysis session per week, table (2) showed that most of children (95%) received 3 dialysis sessions per week, while the minority (5%) received 4 sessions per week and the mean number of dialysis session per week was 2.05 ± 0.22 . The duration of each dialysis session in hours, the majority of children (92.5%) were 4 hours, while the minorities (7.5%) were between 3 to 4 hours, and the mean duration of each dialysis session was 2.92 ± 0.26 hours.

Table (3) illustrated that slightly more than one third of children (35%) the disease duration were between 6-<9 years, followed by less than one quarter

(22.5%) were between 3-<6 years, while the minority (10%) were 9- <12 years, and the mean duration of diseases was 6.20 ± 3.59 years. Concerning duration of dialysis, two fifth of children (40%) were between 3-<6 years, followed by more than one third (35%) were between 0<3 years, while the minority (5%) were 9- <12 years, and the mean duration of dialysis was 3.99 ± 2.55 years. As regard to duration of last AV fistula (age of fistula) it was noted that, more than half of children (52.5%) were between 0<3years, followed by more than one third (37.5%) were between 3-<6 years, the minority (2.5%) were 9-<12 years, and the mean duration was 3.26 ± 2.34 years. There were highly statistically significant difference between duration of diseases, dialysis and last AV fistula ($X^2=36.20, p=.000$).

Figure (3) showed that the majority of children (80%) didn't prefer change puncture site as it increase pain sensation, while the minority of children (20%) preferred changing to prevent increase opening size of puncture site and occurrence of bleeding.

Table (4) showed that more than one third of children in control group (days 1, 2) had moderate or mild pain during artery needle puncture (35%, 37.5% respectively), while less than half of children in study group (days 3, 4) had mild pain or no pain (42.5%, 45% respectively). The same table illustrated that the mean of Wong-Baker faces pain scores during artery needle puncture reduced in the study group (days 3, 4) ($0.82\pm 0.84, 0.75\pm 0.80$ respectively) than the control group (days 1, 2) ($1.57\pm 1.35, 1.60\pm 1.25$ respectively). Also reduced in the study group (day 4) (0.75 ± 0.80) than study group (day 3) (0.82 ± 0.84).

Regarding pain during vein needle puncture, table (4) revealed that more than one third of children in control group (days 1, 2) had moderate pain during vein needle puncture (32.5%, 42.5% respectively), while less than two third of children in study group (days 3, 4) had mild pain and no pain (45%, 57.5% respectively). The same table showed that the mean of Wong-Baker faces pain score during vein needle puncture reduced in the study group (days 3, 4) ($0.97\pm 0.99, 0.77\pm 1.12$ respectively) than the control group (days 1, 2) ($1.77\pm 1.49, 1.90\pm 1.21$ respectively). Also reduced in the study group (day 4) (0.77 ± 1.12) than study group (day 3) (0.97 ± 0.99).

Concerning Wong Backers pain rating scales during artery needle puncture, table (5) showed that there were statistically significant differences between control group (day 1) and study group (days 3, 4) ($x^2=24.89, p=0.05, x^2=25.61, p=0.04$ respectively). There were statistically significant differences between study group (days 3, 4) ($x^2=23.95, p=0.004$).

Regarding to Wong Backers pain rating scale during vein needle puncture, table (5) showed that

there were statistically significant differences between control group (day 1) and study group (day 4) ($\chi^2=42.38, p=0.002$). There were statistically significant differences between control group (day 2) and study group (day 3) ($\chi^2=33.12, p=0.03$). Also there were statistically significant differences between study group (days 3, 4) ($\chi^2=31.37, p=0.01$).

Table (6) revealed that there were obvious negative correlations between duration of disease,

duration of dialysis and AVF with subjective pain scores in the study group (day 4) (vein site) ($r= - 0.345, p=0.029, r= - 0.378, p = 0.016, r= - 0.310, p = 0.052$ respectively). There was no correlation between child age and subjective pain score in the study group (day 4) ($r= - 0.054, p =0.743, r=0 .009, p =0.954$ respectively).

Table (1) Percentage distribution of sociodemographic characteristic of children (n=40)

Characteristics	NO	%
-Gender		
Male	18	45
Female	22	55
-Age (in years)		
8- <12	17	42.5
12- <16	22	55
16+	1	2.5
Means \pm SD	11.72 \pm 1.74 years	
-Number of sibling		
1-2	16	40
3-4	17	42.5
5+	7	17.5
Means \pm SD	3.12 \pm 1.74	
-Rank		
1-2	17	42.5
3-4	17	42.5
5+	6	15
-Residence		
Urban	19	47.5
Rural	21	52.5

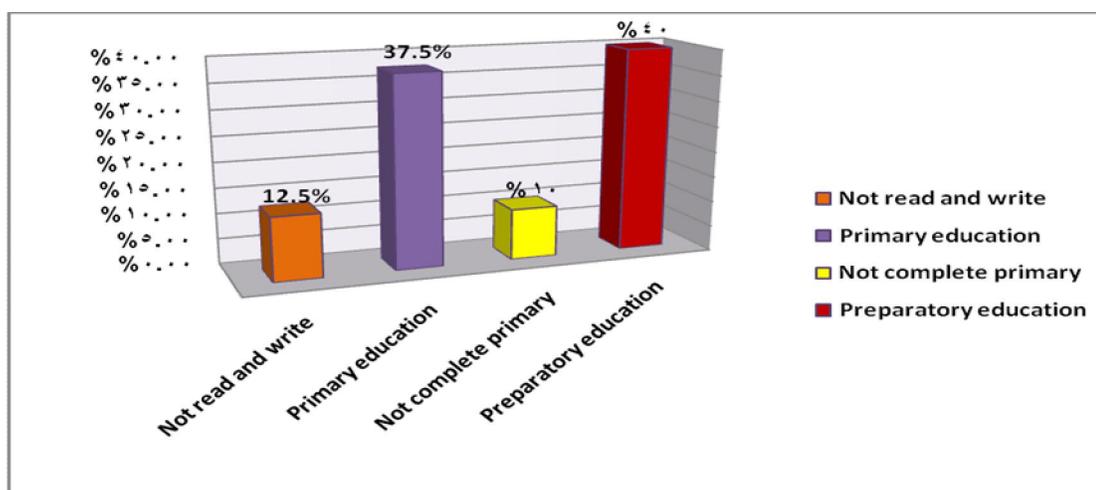


Figure (1) Child education

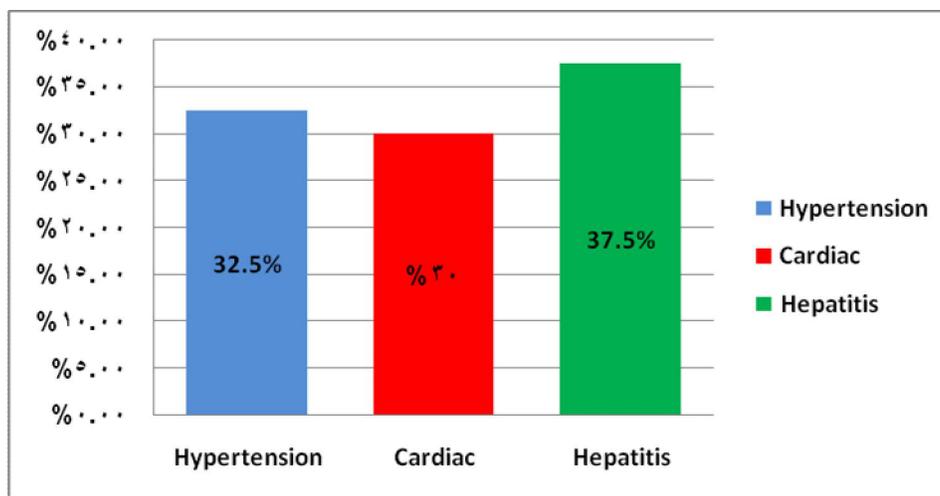


Figure (2) Diseases associated with dialysis

Table (2) Percentage distribution of medical history of studied children (n=40)

Characteristics	No	%
-Number of dialysis session / week		
3	38	95
4	2	5
Means ± SD	2.05±0.22	
-Duration of each hemodialysis session /hrs		
3	3	7.5
4	37	92.5
Means ±SD	2.92±0.26	

Table (3) Comparison between duration of disease, dialysis and last AV fistula among studied children in percentage distribution (n=40)

Duration (years)	Disease		Dialysis		last AV fistula (age of fistula)		X ²	P
	No	%	No	%	No	%		
0<3	8	20	14	35	21	52.5	36.20	0.000**
3-<6	9	22.5	16	40	15	37.5		
6-<9	14	35	8	20	3	7.5		
9-<12	4	10	2	5	1	2.5		
12-<14	5	12.5	0	0	0	0		

* P < 0.05

** P < 0.00

** P < 0.000

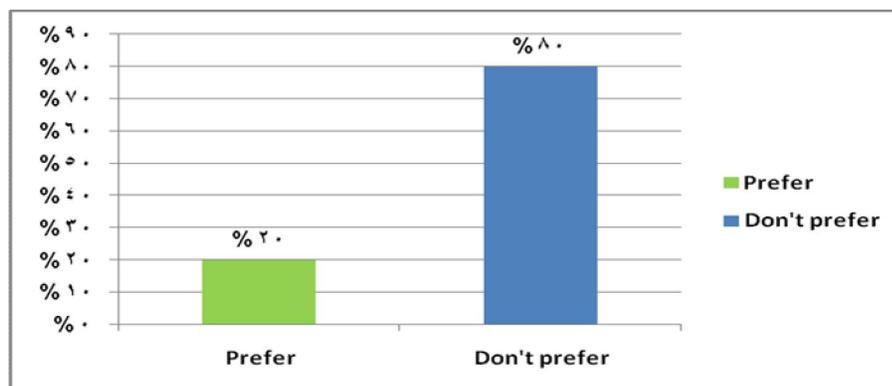


Figure (3) Preference of changing puncture site

Table (4) Level of pain during needle puncture according total scores of Wong Backers pain categories among study and control group in percentage distribution (n=40)

Site of needle puncture	Level of pain	Control group (No Cryotherapy)				Study group (Cryotherapy)			
		Day 1		Day 2		Day 3		Day 4	
		No	%	No	%	No	%	No	%
Artery needle	No pain (0)	10	25	7	17.5	16	40	18	45
	Mild (2)	11	27.5	15	37.5	17	42.5	15	37.5
	Moderate (4,6)	14	35	14	35	7	17.5	7	17.5
	Severe (8,10)	5	12.5	4	10	0	0	0	0
Means ± SD		1.57±1.35		1.60±1.25		0.82±0.84		0.75±0.80	
Vein needle	No pain (0)	9	22.5	3	7.5	14	35	23	57.5
	Mild (2)	10	25	15	37.5	18	45	9	22.5
	Moderate (4,6)	13	32.5	17	42.5	7	17.5	7	17.5
	Severe (8,10)	8	20	5	12.5	1	2.5	1	2.5
Means ±SD		1.77±1.49		1.90±1.21		0.97±0.99		0.77±1.12	

Table (5) Comparison between the control and study group regarding total scores of Wong Backers for measuring child pain during needle puncture (n=40)

Site of needle puncture	Wong Backers Scores		Control group (No Cryotherapy)		Study group (Cryotherapy)	
			Day 1	Day 2	Day 1	Day 2
Artery needle	Control group	Day 1		X ² =29.20 P=0.25	X ² =24.89 p=0.05	X ² =25.61 p=0.04
		Day 2	X ² =29.20 p=0.25		X ² =17.40 p=0.295	X ² =15.17 p=0.43
	Study group	Day 3	X ² =24.89 p=0.05*	X ² =17.40 p=0.29		X ² =23.95 p=0.004
		Day 4	X ² =25.61 p=0.04*	X ² =15.17 p=0.43	X ² =23.95 p=0.004**	
Vein needle	Control group	Day 1		X ² =27.87 p=0.31	X ² =30.54 p=0.06	X ² =42.38 p=0.002**
		Day 2	X ² =27.87 p=0.31		X ² =33.12 p=0.03*	X ² =30.17 p=0.06
	Study group	Day 3	X ² =30.54 p=0.06	X ² =33.12 p=0.03*		X ² =31.37 p=0.01*
		Day 4	X ² =42.38 p=0.002**	X ² =30.17 p=0.06	X ² =31.37 p=0.01*	

* p < 0.05

** p < 0.01

*** p < 0.000

Table (6) Relation between sociodemographic data of children with subjective pain total scores (Wong backers score)

	Subjective pain score (Wong backers score)			
	Day 3 (artery)	Day 4 (artery)	Day 3 (vein)	Day 4 (vein)
	r	r	r	r
Age	.154 <i>P</i> = .342	-.054 <i>P</i> = .743	.193 <i>P</i> = .234	.009 <i>P</i> = .954
Sex	.292 <i>P</i> = .067	.283 <i>P</i> = .077	.181 <i>P</i> = .264	.134 <i>P</i> = .410
Education	.288 <i>P</i> = .071	.136 <i>P</i> = .402	.169 <i>P</i> = .296	.072 <i>P</i> = .657
Duration of disease	-.174 <i>P</i> = .282	-.155 <i>P</i> = .339	-.112 <i>P</i> = .493	-.345 <i>P</i> = .029*
Duration of dialysis	-.048 <i>P</i> = .769	-.168 <i>P</i> = .300	-.013 <i>P</i> = .934	-.378 <i>P</i> = .016*
Duration of AVF	.000 <i>P</i> = .999	-.063 <i>P</i> = .700	.014 <i>P</i> = .933	-.310 <i>P</i> = .052*
Number of session	-.089 <i>P</i> = .583	-.072 <i>P</i> = .660	-.110 <i>P</i> = .498	-.161 <i>P</i> = .322

* *P* < 0.05

4. Discussion

The result of the present study revealed that more than half of children were female (table 1). This finding agrees with Mohamed (2009), who found that more than half of children were female and more than one third were male. While this result disagreed with Ahmed (2008), who found that, more than half of the studied children were males. Faheem *et al.* (2009) found that more than half were male and more than one third were female.

Children ages in the study ranged between 12-16 years and the mean age was 11.72±1.74 years (table 1). In the same context Mahmoud *et al.* (2009), found that more than three quarters of children their age were 13-16 years and the mean age of children undergoing hemodialysis was 13.75±1.4 years. While the result disagree with Faheem *et al.* (2009), whom found in their study that children (total number =30) undergoing hemodialysis their ages ranged from 11-18 years and the mean age was 15.0±2.31 years.

Regarding to children education, less than half of children had preparatory, while the minority didn't complete primary education (figure 1). These finding was supported by Ahmed (2008), who found that 44.4% of children were in preparatory education, and 25% were secondary education. On the contrary, Mahmoud *et al.* (2009), found that 63.75% of children were

illiterate and 30% had preparatory education, 6.25% secondary education.

It was found that less than half of children were the first or second child in the family and they had 3-4 siblings (table 1). This result goes in line with Hassan (2007), who found that more than two thirds of children were the first to fourth child in the rank order and less than three quarter of children had one to four siblings, and the mean number of sibling was 3.36±1.79.

In relation to residence more than half of children were from rural regions (table 1). These results are in contrast with Ahmed (2008), who reported that the highest percentages of children undergoing hemodialysis were living in urban area. Mahoney *et al.* (2010) stated that cultural differences may exist which influence adults' and children's behavior, reaction, and responses to pain and distress during needle procedure.

Regarding to medical history of children, it was found that, more than one third of children had hepatitis (table 2). These finding agree with Manuti (2009), who found that the incidence of hepatitis (B & C) infection is high (24%) in arteriovenous fistula but in temporary catheter 30% especially hepatitis C because the patient exposed to infection. Also Votroubek, & Tabacco (2010); El-Taair *et al.* (2011), found that complications of HD, in addition to infection, include

hypertension, fluid overload, air embolism, seizures, and cardiac arrest.

More than one quarter of children had hypertension and cardiac disease (figure 2). These finding congruent with Fadel *et al.* (2009), who found that patients with end stage renal disease have a variety of complication including hypertension and heart failure. Also Mahmoud *et al.* (2009), found that the highest percentage of children had heart disease followed by hepatitis (30%), while the lowest percentage (6.25%) of them had hypertension

As regard number of dialysis session per week, most of children received 3 dialysis sessions per week, while the minority received 4 sessions per week (table 2). The current study result is in consistent with Mahmoud *et al.* (2009), who found that all children were less than three dialysis per week. On the same context Ward & Hisley (2009); Votroubek, & Tabacco (2010) noted that whereas the human kidney works 24 hours a day, pediatric HD is generally 3 times weekly. Concerning the duration of each dialysis session, the majority of children the duration were 4 hours, while the minorities were between 3 to 4 hours (table 2). These findings were matched with Ghai *et al.* (2009); Hockenberry and Wilson (2009), who noted that hemodialysis procedure is usually performed three times per week for 4 to 6 hours, depending on the child's size.

Slightly more than one third of children the disease duration were between 6-<9 years, followed by less than one quarter were between 3-<6 years, while the minorities were 9- <12 years, and the mean duration of diseases was 6.20 ± 3.59 years (table 3). The current study finding was consistent with other study carried out by Faheem *et al.* (2009), who found that the duration of illness of these children under regular hemodialysis therapy were ranged from 2-15 years (6.80 ± 3.35). On the contrary, Hassan (2007) found that the highest percentage of children had disease from 2 to less than 4 years.

Concerning duration of dialysis, the highest percentage of children were between 3-<6 years, followed by more than third were between 0<3 years, while the minority were 9- <12 years, and the mean duration of dialysis was 3.99 ± 2.55 years (table 3). On the same context Ahmed (2008) stated that half of the children had the first hemodialysis session since 3-4 years, 27% since 1-2 years, and only 5.8% had the first dialysis since less than one year.

Also Faheem *et al.* (2009), found that the duration of hemodialysis for these children under regular hemodialysis therapy, were ranged from 1-10 years (4.0 ± 2.69). While the current study results disagree with Mahmoud *et al.* (2009), who noted that more than half of children their onset of hemodialysis were between 5<10 yrs, 21.25% were between 5<10 years,

while 16.25% were <5yrs and the mean onset of hemodialysis 7.7 ± 3.0 .

As regard to duration of last AV fistula (age of fistula) it was noted that, more than half of children were between 0<3years, the minority were 9-<12 years, and the mean duration was 3.26 ± 2.34 years (table 3). In a similar study done by Çelik *et al.* (2011) they found that age of fistula for patients (total number = 41) undergoing hemodialysis were 4.0 ± 3.3 years. The researcher attributes the short age of AVF may be due to failure of vascular access.

The majority of children didn't prefer change puncture site as it increase pain sensation while the minority of children preferred changing to prevent increase opening size of puncture site and occurrence of bleeding (figure 3). The result agree with Ward *et al.* (2010) who mentioned that an early recommendation was to change the site of the puncture for each dialysis treatment in order to allow for healing of the puncture wound and, therefore, to avoid complications such as hematoma at the puncture site, dilatation, stenosis, infection, and pseudoaneurysm. But to the contrary, other data indicate that insertion of the hemodialysis needles in exactly the same spot for consecutive dialyses (the buttonhole method) may actually be associated with fewer pain complications when compared with using different needle insertion sites for each dialysis treatment.

There was decrease in the mean of Wong-Baker faces pain score during artery needle puncture in the study group in days 3, 4 than the control group in days 1, 2 (table 4). These finding are in agreement with Mansy *et al.* (2010), who found that children's pain scores taken by Oucher Scale after cold therapy, the results revealed that the mean pain score was 2.33 ± 2.294 for the cold therapy group, 6.13 ± 2.360 for the control group which means that cold therapy was effective pain management method in reducing pain self report scores associated with injection among children. Regarding pain during vein needle puncture (table 4) revealed that, there was decrease in the mean of Wong-Baker faces pain score during vein needle puncture in the study group in days 3, 4 than the control group in days 1, 2. This finding supported by Abu Bakr *et al.* (2009) and Çelik *et al.* (2011), who found that pain scoring decreased significantly in the cryotherapy study group with using a superficial cooling while increased significantly in the control group.

There was decrease in the mean of Wong-Baker faces pain score during artery and vein needle puncture in the study group in day 4 than study group in day 3 (table 4). From the researcher point of view that pain score reduced in the study group in day 4 than study group in day 3 could be related to child

skin adapt with cryotherapy procedure and child became more interested with procedure and not afraid from increase duration of cryotherapy time that produce more analgesic effect that observed in the fourth day than third day with cryotherapy intervention.

Concerning Wong Backers pain rating scale during artery needle puncture, there were statistically significant differences between control group in day 1 and study group in days 3, 4 (table 5). These finding congruent with Sabitha *et al.* (2008) whom found that the subjective pain scores were found to be significantly ($P = 0.001$) reduced within the experimental group with the application of cryotherapy.

In regarding to Wong Backers pain rating scale during vein needle puncture, there were statistically significant differences between control group in day 1 and study group in day 4. There were statistically significant differences between control group in day 2 and study group in day 3 (table 5). These finding are in the same line with Mansy *et al.* (2010), who found that there was statistical significant difference between cold therapy group and control group which means that cold therapy was effective pain management method for decrease pain associated with injection.

There were obvious negative correlations between duration of disease, dialysis and AVF with subjective pain scores in the study group day 4 (vein site) (table 6). These findings contradicted with Sabitha *et al.* (2008) who found that there was no significant correlation between the AV fistula puncture pain scores and variables such as the duration of AV fistula use. The researcher attributes these finding to the coping of children with prolonged chronic illness and dialysis so they feel pain less than children start dialysis for short time.

There was no correlation between child age and subjective pain scores in the study group day 4 (table 6). The result agrees with Sabitha *et al.* (2008); and Mansy *et al.* (2010), whom found that no significant difference between age groups regarding pain self report scores. The results in the same line with Ingalls *et al.* (2010); Çelik *et al.* (2011), whom found that there was no significant relationship regarding pain (VAS score) and age, gender. The results disagree with Parruti *et al.* (2010), who reported that intensity of pain (VAS score) was significantly associated with female gender, older age.

5. Conclusion

The current study concluded that cryotherapy was effective on reducing subjective pain scores (Wong Backer faces pain rating scores) at puncture sites of arteriovenous fistula among children undergoing hemodialysis. Duration of disease and duration of

dialysis correlated negatively with subjective pain score in day 4. There was no correlation between child age and subjective pain scores in the study group in day 4.

Recommendations

The study recommended that:

- Hemodialysis units should involves cryotherapy for managing needle puncture pain in the routine care for hemodialysis children.
- Apply the same study on a larger group of children with different age groups, in different seasons, in different clinical setting, and children with different diagnosis.
- Study the impact of different cryotherapy agents (e.g vapocoolant spray, gel, crushed ice ...etc) on pain of AVF puncture.
- Compare the impact of cryotherapy with other non pharmacological pain management methods such as relaxation, breathing exercise in managing arteriovenopuncture pain among hemodialysis children.

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