EFFECT OF LOCAL REFRIGERATION PRIOR TO VENIPUNCTURE ON PAIN RELATED RESPONSES IN SCHOOL AGE CHILDREN

Ali Fakhr Movahedi RN, MSN, Department of Paediatric Nursing, Faculty Member in Nursing and Allied Health College, Semnan University of Medical Sciences, Semnan, Iran.

Alimovi @ sem-ums.ac.ir

Shahnaz Rostami RN, MSN, Department of Paediatric Nursing, Faculty Member in Nursing and Midwifery College, Ahwaz Jondishapour University of Medical Sciences, Ahwaz, Iran.

Mahvash Salsali RN, PhD, Associate Professor of Nursing and Midwifery Faculty, Tehran University of Medical Sciences, Tehran, Iran.

Bijan Keikhaee MD, Associate Professor of Haematologic Department, Member of Medicine Faculty, Ahwaz Jondishapour University of Medical Sciences, Ahwaz, Iran.

Afshin Moradi MD, Assistant Professor of Department of Pathology, Medicine Faculty, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

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ABSTRACT

Introduction:

Painful medical procedures are the major sources of distress among children; and for those with chronic diseases, the procedure-related pain can be worse than that of the illness itself.

Objective:

The purpose of the study was to determine the effect of local refrigeration prior to venipuncture on pain-related responses in school-age children.

Design:

Quasi-experimental study.

Setting:

This study was undertaken in a paediatric emergency ward of a paediatric centre.

Subjects:

The subjects were 80 children 6 to 12 years of age selected by purposive sampling after being referred to the paediatric emergency ward.

Interventions:

Two groups were chosen for the study: the test and control groups, in order to test the effect of local coldness in reducing the pain of venipuncture. In the test group, the injection site was refrigerated for three minutes using an ice bag. In the control group, the procedure was performed according to usual routine. Physiological responses (ie. blood pressure, pulse, and respiration), behavioural responses (using the Children's Hospital of Eastern Ontario Pain Scale: CHEOPS), and subjective responses (or intensity of pain using the Oucher scale) were measured in the two groups.

A non-invasive (electronic) sphygmomanometer was used before and 5 minutes after the procedure to measure the physiological responses. The measurement of behavioral responses by CHEOPS was done at two time points (during the procedure and 5 minutes after the procedure), measuring six areas of behavior: cry, facial expressions, child verbal, torso, touch and leg movement in reaction to painful stimulation. Finally, the subjective responses were measured at 5 minutes after the procedure.

Main outcome measures:

In this study the main outcome measures were: range of physiologic responses, and scores of behavioral and subjective responses. The study hypothesised there would be a lower score in the test group than the control group in behavioural and subjective responses and a lower range in physiologic responses.

Results:

Results showed no significant difference between the two groups for physiological responses (before and after procedure). However behavioural responses during and after the procedure (p=0.0011), and subjective responses after the procedure (p=0.0097) were significantly lower (ie. the test group had lower scores in behavioural and subjective responses compared to the control group.

Conclusion:

The results of this study suggest that the use of local refrigeration prior to venipuncture can be considered an easy and effective intervention of reducing venipuncture-related pain.

INTRODUCTION

Illness and hospitalisation expose children to unfamiliar and unpleasant feelings. Since children have little experience with and comprehension of the pain and disease process, such negative feelings cause intimidation and anxiety for them (Baucher et al 1994). Although the degree of pain during common medical procedures is less than during severe illnesses and injuries, millions of children experience these procedures which cause considerable distress. Children requiring needle sticks (injections, intravenous catheters, blood sampling) view this procedure as frightening and a significant source of pain (Kharasch 2003).The results of one study conducted on children who were inpatients in a tertiary care hospital (excluding neonatal ICU and psychiatry patients) and one parent per child, indicated that 49% of the 200 subjects (102 parent interviews for children less than 5 years of age and 98 child interviews for children 5 years of age and older) reported clinically significant levels of severe pain. Approximately 21% of these subjects had clinically significant levels of usual pain during the past 24 hours; the causes of pain were variable from such sources as disease, surgery, and intravenous (IV) lines (Cummings et al 1996).

Intrusive procedures such as venipuncture are well understood as stressful events for children (Caty et al 1997). Venipuncture in the paediatric population can be one of the most distressing events associated with medical encounters (Rogers and Lynne 2004). For example, in one study data were obtained by means of a projective technique and guided interview format using a set of black and white line drawings that depicted the three phases of venipuncture. These researchers found two thirds of the children (66.6% of 45 children) considered the anticipatory phase of venipuncture as a threat. Slightly more than half the children also appraised the impact phase as a threat (Caty et al 1997).

In another study when subjects were asked how the child in the picture (ie. an illustration of a gender-neutral, school-aged child standing in the doorway of a blood-collection room and poised to enter a room which was similar to that of the clinic used for the study) might perceive the impending blood collection, 82.1% of subjects expressed negative emotions such as nervous, scared, terrible, not good, angry and sad (Hodgins and Lander 1997). Furthermore, in a sample of 150 hospitalised children between the ages of 3 and 18 years, the three most commonly reported painful procedures were needle procedures, intravenous insertion, venipuncture and injections (Lewkowski et al 2003).

The role and responsibility of health care workers, particularly nurses, includes helping children through such procedures. The nurse caring for a child during a procedure is presented with a double challenge: helping the child and parents through the procedure effectively, and ensuring that the procedure is done as efficiently as possible (Breman 1994). Total pain relief during procedures should be the goal of methods to reduce the pain accompanying invasive procedures such as venipuncture, to help improve patient care and increase patient satisfaction.

Non-pharmacological techniques to reduce venipuncture related pain and avoid potential drug side effects are generally less costly and can be performed independently by nurses (Jacobson 1999). A number of non-pharmacological techniques, such as distraction, relaxation, guided imagery, and cutaneous stimulation provide coping strategies that may help reduce pain perception, make pain more tolerable, decrease anxiety and enhance the effectiveness of analgesics (Wong and Hockenberry 2003). Among these measures, the proper use of cutaneous stimulation can reduce pain perception (Crisp and Taylor 2005). Cutaneous stimulation is performed by several methods such as simple rhythmic rubbing, use of pressure or electric vibrators, massage with hand and application of heat or cold at the site before injection, which has been significantly valued in various studies (Wong and Hockenberry 2003).

Cold and heat application relieve pain and promote healing (Crisp and Taylor 2005). An application of cold is considered to slow the ability of pain fibres to transmit pain impulses (Ball and Bindler 2003). Although there is not any agreement on the pain transmission theory, Gate Control Theory is widely supported by researchers. According to Gate Control Theory, researchers have viewed pain as a multidimensional construct leading to improvements and advancement of many interventions (Abott and Fawler 1995). The results of one study indicated the reduction of pain at the injection area after applying skin refrigerant/anesthetic (Maikler 1991), whilst according to another study, refrigerant local anesthetic spray reduced injection pain during routine diphtheria, pertussis, and tetanus (DPT) immunisation (Abott and Fawler 1995).

Considering the anxiety due to painful procedures such as venipuncture, as well as the unpleasant feelings parents and children get, it was hypothesised that application of local refrigeration to the skin would decrease the pain-related responses associated with venipuncture.

METHOD

Study design

This research was a quasi-experimental study. Its purpose was to determine the effect of local refrigeration applied to skin prior to venipuncture on pain-related responses in school-age children.

Setting and sample

The study was conducted with 80 children aged 6 to 12 years that accessed the emergency ward in the paediatrics center in Ahwaz Jondishapour University of Medical Sciences, Ahwaz, Iran.

In this study, subjects were selected by purposive sampling and were divided into two equal groups: test and control.

The effect on the magnitude of pain severity reduction considered from a behavioural response was measured using a 13 point scale (CHEOPS) with a minimum of 4 points (meaning no pain). The subjective response was measured based on a 100 point scale (Oucher scale) with a minimum of 0 points (meaning no pain), with a significance level of 0.05 and test power of 0.8. A pilot study determined a standard deviation of 1.5 related to behavioral response in the test and control groups, and approximately 30 for the subjective response. The magnitude of pain reduction was at least 1 point and 20 points based on behavioural and subjective responses respectively.

Data collection

To facilitate a multidimensional approach, physiological, behavioural and subjective responses were collected from each child. Physiological responses consisted of pulse, respiration and blood pressure. Measurements were made manually for the respiratory rate and the non-invasive electronic sphygmomanometer was used for pulse and blood pressure by attaching it to the child's arm. The physiological responses were recorded just before the procedure and 5 minutes after procedure.

The Children's Hospital of Eastern Ontario Pain Scale (CHEOPS) was used to collect behavioural responses in children (Wong and Hockenberry 2003). The data was recorded during the procedure and 5 minutes after the procedure. The CHEOPS is one of the few behavioural tools developed to measure pain-related behavior in infants and children. It is based on pain behaviours observed most frequently in children in the first post-operative hours and measures six areas of behavior and each behavior value: cry (1-3); facial (0-2); child verbal (0-2); torso (1-2); touch (1-2); and legs (1-2). For example, the behaviour choices for the cry are: no crying (score 1); moaning (score 2); crying (score 2); and screaming (score 3) (Carter 1994). The possible global score range is 4 to 13.

Research results of one study have indicated an inter-rater reliability of 80% or higher (Van-Cleve et al 1996), while the inter-rater reliability for our study was 93%. Although CHEOPS is used frequently for children during the post-operative phase, some researchers studied 171 children and adolescents aged 3 to 17 years requiring venipuncture and concluded that CHEOPS is valid for use when there is short, sharp pain such as with drawing blood (Van-Cleve et al 1996).

The Oucher is a self-reporting instrument that measures pain intensity by verbal reporting in children aged 3 to 12 years. It has a vertical numerical scale (0 to 100) on one side and six photographs of a young child's face on the other side, arranged to convey increasing discomfort. The assumption is that children, who can count to 100, can use the numerical symbol scale and those who cannot, compare the intensity of their pain to the photographs (Beyer and Wells 1989; Wong and Hockenberry 2003). In this study for the collection of subjective responses, researchers ask the child about his/her intensity of pain after the procedure. The child then specified on the 0-100 Oucher scale (for children who can count to 100 or using pictures for those who cannot) his/her intensity of pain when venipuncture is carried out.

The Oucher has been tested for validity and reliability and is widely used for clinical and research purposes. The correlation between Oucher and the Visual Analog Scale for pain has been reported to be 0.89 ($p<0.01$) (Kleiber 2002).

Procedure

In this study, 80 subjects were selected from presenting 6 to 12 year olds and were divided into two equal groups: test and control. In the test group, physiological responses were measured prior to venipuncture at two time points. Then the skin on the area of intravenous insertion (antecubital fossa) was refrigerated by an ice bag for 3 minutes and the procedure was performed immediately after. The behavioral responses were also measured (CHEOPS 1) during the procedure. Five minutes after the procedure, the physiological responses, behavioural responses (CHEOPS 2) and subjective (self-reported) responses were measured. In this study CHEOPS and Oucher scales convert behavioural and subjective responses to numeric form. Finally after data collection, the t-test was statistically used to compare the means of the two groups using the SPSS program version 10.

Ethical considerations

According to the recommendation of the nursing department's ethical committee, the researcher fully explained the study and method of skin refrigeration to parents and their child, and assured the right of refusing to participate in study.

RESULTS

In terms of the physiological responses before and after the procedure in the test and control group, there was no significant difference ($p=0.07$) between the two groups (table 1, 2).

Table 1: Comparison of mean value of the physiological responses prior to venipuncture in the test and control groups.

Physiologic Responses	Control Group		Test Group		P-value
	Mean	Standard Deviation	Mean	Standard Deviation	
Systolic Pressure	108.700	15.252	106.225	14.795	0.07
Diastolic Pressure	74.525	13.247	70.450	11.710	
Pulse Rate	92.850	17.520	92.250	23.019	
Respiratory Rate	20.675	4.002	19.950	3.973	

Table 2: Comparison of mean value of the physiological responses after venipuncture in the test and control groups.

Physiologic Responses	Control Group		Test Group		P-value
	Mean	Standard Deviation	Mean	Standard Deviation	
Systolic Pressure	101.875	12.214	102.025	9.667	0.07
Diastolic Pressure	69.775	11.369	67.450	10.404	
Pulse Rate	89.725	20.278	92.675	18.115	
Respiratory Rate	21.150	4.953	20.100	4.244	

However there was a significant difference (p=0.0011) between the test and control groups (table 3) with regard to the behavioural responses (CHEOPS 1 and CHEOPS 2) to the painful procedure.

Table 3: Comparison of mean value of the behavioral responses during (CHEOPS 1) and after (CHEOPS 2) the venipuncture in the test and control groups.

Behavioral Responses	Control Group		Test Group		P-value
	Mean	Standard Deviation	Mean	Standard Deviation	
CHEOPS 1	9.950	1.796	8.475	1.501	0.0011
CHEOPS 2	6.000	0.905	5.325	0.797	

There was also a significant difference (p=0.0097) in the subjective (self-reported) data in the two groups after venipuncture (table 4).

Table 4: Comparison of mean value of the subjective (self - reported) responses after the venipuncture in the test and control groups.

Subjective Responses	Control Group		Test Group		P-value
	Mean	Standard Deviation	Mean	Standard Deviation	
Oucher Scores	42.750	32.501	30.750	29.732	0.0097

DISCUSSION

Health care professionals have a duty to provide compassionate care to all children (Zempsky et al 2004). Insertion of peripheral intravenous devices is one of the most painful and frequently performed invasive procedures by nurses. Effort should be made to assess and manage acute pain as, by doing so, nurses can reduce pain, increase patient comfort and satisfaction, improve patient outcomes, and shorten hospital stays (Jacobson 1999).

The purpose of this study was to evaluate the efficiency of local refrigeration of skin prior to venipuncture as a non-pharmacological and non-invasive intervention to reduce the pain related response to the painful procedure. In this study we anticipated that the physiologic response would change in the test group compared to the control group; however results showed no difference in physiologic responses. This finding was similar to one study where there were no significant differences in physiological variables before and after the painful procedure in pre-school and school age children (Van-Cleve et al 1996).

Therefore it may be said that in short painful procedures, it is possible to detect the physiological changes indicated in autonomic arousal, however adaptation rapidly occurs and the autonomic responses return to normal. For this reason, there are no physiological responses that directly reflect the child's perception of pain (Beyer and Wells 1989).

However in this study, we found significant differences in the behavioural and subjective responses between test and control groups with pain responses being lower in the test group. Several physical strategies have demonstrated efficacy in pain management for children. These include the use of heat, cold, and massage (Zempsky and Schenchter 2003). Cold application is also effective before invasive needle puncture (Crisp and Taylor 2005). Albeit not directly related to our study on venipuncture, results of other studies have shown that the application of refrigerant spray on the injection area is a simple and effective therapeutic method for pain relief before painful procedures (Abbott and Fawler 1995; Maikler 1991). Other authors argue for the therapeutic use of ice as a form of hyperstimulation analgesia (Davis 2000). Also, some consider that application of an ice cube on the site before giving an injection can be considered as a cutaneous stimulation technique for non-pharmacological pain relief (Wong and Hockenberry 2003). The application of ice relieves the pain. One possible option to minimise the effects of injection on children is immediate application of ice before injections (McCaffery 1994).

Finally, considering the fact that verbal reports are more widely used and considered standard, as well as behaviours being instinctive responses to pain (Tesler et al 1998), this study demonstrates that the application of local refrigeration by ice on the skin prior to venipuncture is a safe and simple method to reduce pain related responses in school-age children.

CONCLUSIONS

This study found that during venipuncture local refrigeration is effective in relieving pain associated with the procedure, however more research about the effectiveness of this intervention on other age groups in children, and on other painful procedures are needed. To enhance understanding of pain in children and the assessment of paediatric pain responses, especially physiologic responses, further research will be required. This study supports the assumption that paediatric nurses need to accept and assess a child's pain correctly, especially during painful procedures. However nurses need to expand their knowledge, increase their

responsibility and be more involved in relieving paediatric pain and suffering, including the exploration of non-pharmacologic interventions.

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