Efficacy of Eutectic Mixture of Local Anesthetic Cream and Vibrator Device in Pain Reduction during Peripheral Venous Cannulation in a Tertiary Care Center of Central Nepal

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ABSTRACT

Background

Venous cannulation is a commonly performed procedure which often leads to patient anxiety. Application of a vibrator device and or prior use of topical anesthetics are proven methods to decrease associated pain.

Objective

To compare the clinical efficacy of prior use of Eutectic Mixture of Local Anesthetic (EMLA) cream and vibrator device in pain reduction during peripheral venous cannulation.

Method

A true experimental study was conducted in November 2019 among 78 patients aged 20-60 years receiving peripheral cannulation at operation theatre. They were included using consecutive sampling and sorted to interventional and non-interventional group using simple random sampling lottery method. Participants in the non-interventional group received peripheral cannulation using routine technique whereas participants in the interventional group received topical Eutectic Mixture of Local Anesthetic cream or vibrator device prior to cannulation. Perceived post cannulation pain intensity was measured using numerical pain rating scale. Kruskal-Wallis test was used for data comparison.

Result

The mean age of the participants was 40.57 ± 12.5 years. The median pain score of Eutectic Mixture of Local Anesthetic cream, vibrator and no intervention was 3, 3 and 6 respectively. The reduction in median pain intensity was significantly greater with topical anesthetic cream and vibrator device when compared to the non-interventional group ($p < 0.05$).

Conclusion

Prior interventions with Eutectic Mixture of Local Anesthetic or vibrator device are useful in reducing pain intensity during peripheral venous cannulation. Routine use of these in day to day practice could be a part of standard nursing care practice.

KEY WORDS

Cannulation, Eutectic mixture of local anesthetic cream, Pain, Venous, Vibrator

INTRODUCTION

Pain is considered to be the fifth vital sign as it evokes a physical response.[1,2] It is an unavoidable and universal sensation to all of us. The International Association for the Study of Pain (IASP) defines pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage".[1] Pain can be categorized as acute or chronic, or in broad headings based on the origin of the insult or related pain fibers.[2]

Peripheral venous cannulation has been identified as one of the most common painful procedures performed by nurses.[3] Topical anesthetics are widely accessible for reduction of pain associated with peripheral venous insertion.[4] A combination of 2.5% lidocaine with 2.5% prilocaine is a common combination often used during peripheral venous cannulation.[5] Effectiveness of vibration sensation in masking pain during peripheral venous cannulation has been tried in pediatric population.[6,7] A distractive stimulus such as rubbing or vibration reduces the transmission of pain stimulus via the pain sensitive A-delta fibres. Based on the gate control theory, numerous clinical studies have been directed to reduce pain during peripheral venous cannulation.[8,9]

Despite the numerous literatures of the above two methods in minimizing pain during peripheral venous cannulation among adults, there has been a paucity of literature while comparing these modalities. Hence we intended to perform a study comparing the efficacy of topical Eutectic Mixture of Local Anesthetic (EMLA) cream and vibration sensation for pain management among adult participants undergoing elective surgery during peripheral venous cannulation.

METHODS

The present study is a true experimental design (post-test only design) meeting the three characteristics of manipulation, randomization and control. The study was conducted among 78 patients aged 20-60 years in the operation theatre of Dhulikhel Hospital, Kathmandu University Hospital from November 3 to 29, 2019. A prior ethical approval from taken from the institutional review board. A written informed consent was obtained from all the participants prior to the procedure. Patients undergoing new intravenous cannulation on forearm for an elective surgery, willing to participate in the study and those who could speak and read Nepali language were included in the study. While patient with prior cannula in situ, patients who were in pain due to chronic disease or trauma, a prior history of allergy to local anesthetic or patients having dual prick of the vein requiring another cannulation were excluded from the study. Participants were selected using non-probability consecutive sampling method.

As a part of true experimental study; the participants were divided into experimental and no intervention groups. For randomization, participants were randomly allocated to experimental and no intervention group using lottery method. The experimental group again had two arms consisting of EMLA group and vibration device group. Independently, 26 chits were coded 1 for EMLA, 2 for vibrator and 3 for no intervention group. Since pain was measured only after patient received intravenous cannulation; post-test design was used in the present study.

Socio-demographic and clinical profile related questionnaires were asked to the participants in open data kit file. In case of Group 1 i.e. EMLA group -1.5 gm of EMLA was measured using fingertip unit (1 fingertip unit = 0.5 gm).[10] Prior allergy test to EMLA cream was performed on the volar aspect of left forearm. This cream was applied to an area of 5 cm^2; 60 minutes prior to intravenous cannulation and was secured using occlusive dressing. EMLA was wiped off with cotton swab and then cannulation was performed with 18-gauge cannula following universal guidelines.

In group 2 i.e. vibrator group, the vibrator device was applied 10 cm proximal to the cannulation site. Vibrator was started 1 minute before cannulation and cannulation performed in a similar fashion. In group 3 i.e no intervention group, routine practice of intravenous cannulation was done with a 18 gauge cannula.

Pain was assessed in each participant 2 minutes after the procedure using the numerical rating scale by the research assistant to minimize researcher bias.

RESULTS

Three cases were excluded from the study; two because of two times cannulation while one surgery was postponed for high heart rate. Table 1 represents the socio-demographic profile of the participants. Table 2 represents the clinical characteristics of the participants'.

Out of 75 cannulation, 39 (52%) were performed in dorsal metacarpal vein followed by 36 (48%) in dorsal venous vein. EMLA was used in 25 (34.7%) of the cases, vibrator was used in 24 (32%) and no intervention was performed in 33.3% of the study participants. Among total population, 40 (53.3%) of the study participants had a history of hospitalization and also history of cannulation.

Figure 1 represents the frequency distribution of level of pain among EMLA, vibrator group and no intervention group. Mild pain was found to be predominantly high in EMLA group followed by vibrator group i.e. 84% and 69.2% respectively whereas no intervention group felt higher percentage of moderate pain (69.2%) as compared to both EMLA and vibrator group. EMLA and vibrator group both did not felt severe pain during peripheral cannulation whereas 19.3% of the no intervention group felt severe pain.

Table 1. Socio–demographic characteristics of the respondents (n=75)

Characteristics	EMLA n=25 n (%)	Vibrator n=24 n (%)	No inter-vention n=26 n (%)	Total n=75 n (%)	p-value
Age group					
Mean age	37.9 ± 12.8	38.6 ± 11.2	44.92 ± 12.80	40.57 ± 12.5	0.057
Gender					
Male	11(42.3)	11(45.8)	14(56)	36(48)	0.92
Female	14(56)	13(54.2)	12(46.2)	39(52)	
Ethnicity					
Brahmin/Chhettri	11(42.3)	14(58.3)	11(42.3)	36(48)	
Janajati	12(48)	7(29.2)	11(42.3)	30(40)	0.425
Others (Madhesi/ Dalit)	2(8)	3(12.5)	4(15.4)	9(12)	
Occupation					
Homemaker	5(20)	7(29.2)	5(19.2)	17(22.7)	
Agriculture	5(20)	2(8.3)	8(30.8)	15(20)	0.533
Service	8(32)	6(25)	7(26.9)	21(28)	
Others (Business/ Unempl oyed/ Student)	7(28)	9(37.5)	6(23.1)	22(29.3)	
Education level					
No education	3(12)	1(4.2)	4(15.4)	8(10.7)	
No formal and Basic	2(8)	4(16.7)	11(42.3)	17(22.7)	0.084
Secondary Educa-tion	4(16)	10(41.7)	3(11.5)	17(22.7)	
Higher education	16(64)	9(37.5)	8(30.8)	33(44)	
Marital status					
Unmarried	0(0)	3(12.5)	1(3.8)	4(5.3)	0.322
Married/widow	25(100)	21(87.5)	25(96.2)	71(94.7)	
History of alcohol intake					
No	16(64)	19(79.2)	15(57.7)	50(66.7)	0.067
Yes	09(36)	5(20.8)	11(42.3)	25(33.3)	

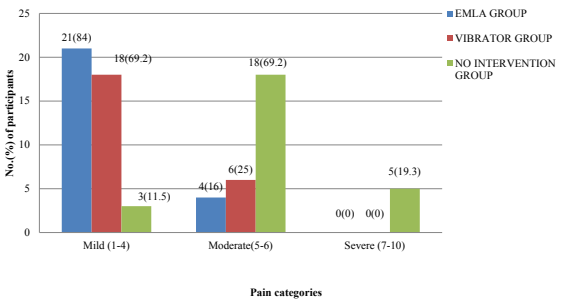

Figure 1. Comparison of Level of Pain between EMLA Group, vibrator group and no intervention Group

Table 2. Clinical characteristics of the participants (n=75)

Clinical Characteristics	EMLA n=25 n (%)	Vibrator n=24 n (%)	No inter-vention n=26 n (%)	Total n=75 n (%)	p-value
BMI categories					
Underweight	01(4.0)	02(8.3)	1(3.8)	4(5.3)	
Normal	12(48.0)	10(41.7)	15(57.7)	37(49.3)	0.19
Overweight	10(40.0)	07(29.2)	8(30.8)	25(33.3)	
Obese	02(8.0)	05(20.8)	2(7.7)	9(12.0)	
Types of surgery					
General surgery	14(56.0)	21(87.5)	17(65.4)	52(69.3)	
Urology	2(8.0)	2(8.3)	1(3.8)	5(6.7)	0.70
Vascular surgery	4(20.0)	0(0.0)	4(15.4)	9(12.0)	
Orthopedic	2(8.0)	1(4.2)	3(11.5)	6(8.0)	
Others (ENT, Eye)	2(8.0)	0(0)	1(3.8)	3(4.0)	
Site of cannulation					
Dorsal venous vein	15(60.0)	9(37.5)	12(46.2)	36(48.0)	0.59
Dorsal metacar-pal vein	10(40.0)	15(62.5)	14(53.8)	39(52.0)	
Previous hospitalization					
No	12(48.0)	10(41.7)	13(50.0)	35(46.7)	0.41
Yes	13(52.0)	14(58.3)	13(50.0)	40(53.3)	
Previous cannulation					
No	12(48.0)	10(41.7)	13(50.0)	35(46.7)	0.41
Yes	13(52.0)	14(58.3)	13(50.0)	40(53.3)	
Previous pain experience during cannulation (n=40)					
Mild	1(4)	2(8.3)	2(7.7)	5(12.5)	
Moderate	4(16)	8(33.3)	5(19.2)	17(42.5)	0.58
Severe pain	2(24)	1(4.2)	1(3.8)	4(10)	
Don't remember	6(24)	3(12.5)	5(19.2)	14(35)	

Table 3 highlights the results of comparison among the median of pain intensity between EMLA group, vibrator group and no intervention group. The median pain score in EMLA group, vibrator group and no intervention group is 6, 3, and 3, 48 respectively. As shown in the table, the median pain intensity is less with EMLA cream and vibrator method compared to that of no intervention group with p value less than 0.01. This rejects the null hypothesis and accepts the research hypothesis. Hence there is significant reduction in pain between interventional groups than no intervention group.

Table 3. Comparison of median pain score between EMLA group, vibrator group and no intervention group using Kruskal-Wallis test (n=75)

Methods (technique used)	Median score (IQR)	Mean rank	Degree of free-dom	Chi square test	Signifi-cance
No intervention	6(1)	58.19			
EMLA cream	3(2)	26.50	2	35.3	p < 0.01*
Vibrator device	3(2.75)	28.10			

Table 4 highlights the pair-wise comparison of EMLA and no intervention group, vibration and no intervention group and EMLA and vibrator group respectively. The p-value of this pair-wise comparison is less than significance level of 0.05 ($p < 0.01$) in EMLA and no intervention group as well as vibrator and no intervention group. This rejects the null hypothesis 1 and 2 and accepts the research hypothesis. Hence both EMLA and vibrator are found to be significantly effective in pain reduction than no intervention group.

Table 4. Pair-wise comparison of EMLA, vibrator and no intervention group using post-hoc test (n=75)

Sample 1-sample 2	p value
EMLA- Vibrator	0.79
EMLA- No intervention	< 0.01*
Vibrator- No intervention	< 0.01*

The box plot in figure 2 represents that the median pain score in no intervention group was higher compared to the median pain score of those who achieved either vibrator or EMLA. This association is statistically significant ($p < 0.05$).

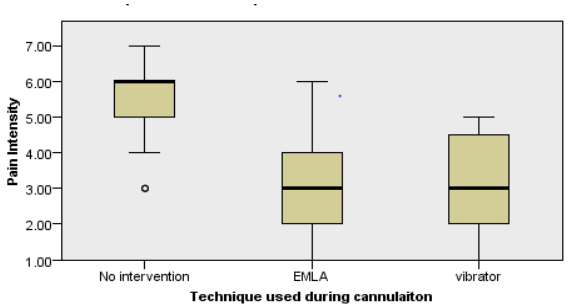

Figure 2. Box plot representing median pain intensity score between EMLA group, vibrator group and no intervention group

DISCUSSION

The present study depicts the comparison between no intervention group, application of EMLA cream and use of vibrator device prior to peripheral venous cannulation in a tertiary care center. As demonstrated in table 1, there are no statistically significant differences between the common variables among three groups viz. age group, gender, educational status, ethnicity, occupation, marital status and history of alcohol consumption.

In the present study, nearly half of participants from all categories had previous experience of venous cannulation. However, no significant association was observed during pain on venipuncture or previous experience of cannulation. Ravneet et al. came forward with the similar findings which revealed no significant association of 51 pain during venipuncture with previous cannulation or number of previous cannulation in experimental and no intervention groups.[11]

In the present study; as demonstrated in table 4, there was a statistically significant reduction in the median pain score in EMLA and vibrator group in comparison to the no intervention participants. This observation accepts the research hypothesis that both EMLA and vibrator are found to be significantly effective in pain reduction than the no intervention group. Topical preparation of EMLA is a local anesthetic when applied before 45 minutes to 2 hour provides adequate analgesia for minor procedures including intravenous cannulation.[12] Similarly external application of vibration sensation supports the gate control theory of pain causing masking of the pain.[13] Hence, both of these modalities have appeared superior to no intervention. Also, while comparing individually EMLA and vibrator device the p-value is greater than 0.01; signifying no statistically significant difference between the two experimental modalities. So, both interventions can be equally effective in pain reduction during peripheral venous cannulation.

A single study similar to the present study is a randomized clinical trial among pediatric population published by Potts et al. comparing a vibrating cold device and topical 4% lignocaine gel to reduce pain prior to venipuncture.[14] Their results concluded that vibration cold device and topical lignocaine showed equal effectiveness in reducing pain and distress for children experiencing intravenous catheter insertion.[14]

The results of the present study are in congruence with a study from India which evaluated and compared the analgesic efficacy of topical non-steroidal anti-inflammatory piroxicam gel versus eutectic mixture of local anesthetic cream (EMLA) applied to the peripheral venous cannulation site in adult volunteers.[15] The study concluded that the pain score with lidocaine prilocaine cream is associated with less pain on cannulation and cannula advancement compared to piroxicam gel. Similarly, Smith et al. evaluated the efficacy of a five-minute application of EMLA cream prior to cannulation for the management of pain associated with intravenous cannulation.[16] Their results have supported the transient use of EMLA cream for five minutes can decrease the pain associated with Peripheral venous callulation than placebo.

A systematic review and network meta-analysis was published in the year 2015 by Bond et al. regarding pain relief techniques for peripheral venous cannulation of adults.[17] A total of 27 suitable studies from past 25 years were analyzed with the above objective. The efficacy of anesthetics including EMLA was estimated to be more effective than no treatment. Similarly, a study was published in the Canadian Journal of Anesthesia by Vaghadia et al. to evaluate the effectiveness of the EMLA patch for dermal analgesia during intravenous cannulation in adult outpatients and in preventing vaso-vagal effects.[18]

This randomized, double-blind, placebo-controlled, parallel-group trial revealed that the EMLA patch, applied for 60-90 min before venous cannulation reduced the pain of venipuncture and vaso-vagal side effects in adult outpatients. The results of this study are in congruence with the present study.

The results of the present study however differ to a study conducted by Secil et al.[19] They evaluated the efficacy of a vibration device to assess the efficacy of vibration on venipuncture pain scores in a pediatric emergency department. Pain during and after venipuncture procedure was evaluated among 60 healthy infants by means of face, legs, activity, cry, and consolability scale before, during, and after the procedure. They concluded that such vibration device did not reduce pain scores in infants during and after venipuncture procedure.

Comparable to the results of the present study are number of studies published in dermatology discipline which involves application of pain in a number of cutaneous procedures which involves pain.[8,20,21] The results are in congruence with the present study stating that there is an ample reduction of cutaneous pain with the prior use of vibrator device.

CONCLUSION

The present study discloses that there is a need for knowledge and practice of applying topical anesthetic cream and or vibrator device for reducing pain during intravenous cannulation. Intravenous cannulation is among the commonest performed procedures by nurses around the globe. The present study stresses that there is a need of adequate time for preparation and training on application of topical anesthetic cream and or vibrator device for patients undergoing intravenous cannulation. Easy availability of anesthetic creams and such vibrator device can ease the procedure. Guidelines in regional or national levels to enforce the use of either EMLA or vibrator device could aid in quality health care service.

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