

Comparing the Effectiveness of EMLA Cream 5% and Ethyl Chloride Spray to Reduce the Pain Associated with Intravenous Cannula Insertion for Adult Patients Undergoing Elective Surgeries :Cross sectional study at Tertiary Care Hospital.

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Abstract

Structured format (introduction and aim, methods, results, conclusion). 1 - 1½ pages

Background: Intravenous cannulation (IV) is the most common practice in hospitals and it is associated with some kind of pain that may cause discomfort for majority of patients. Minimizing the pain by using different local anesthetic techniques such as EMLA cream or ethyl chloride spray could help to make it remembered as a pleasant experience. The aim of this study is to find out the most effective type of local anesthesia in reducing the IV pain in adult patient. Method: Observational cross-sectional study involved 180 adult patients undergoing elective surgeries in King Abdulaziz Medical City (KAMC) hospital specifically in the holding area which is the area where the patient received for IV insertion. The study sample was divided into three groups, and each group consists of 60 patients. The three groups were assigned for three different techniques, which are ethyl chloride spray, EMLA cream,

and no treatment. Primary data was collected from the samples and the data was analyzed by using Statistical Package for the Social Sciences (SPSS version 22). Result: The final sample (N=120) and the majority were females and the mean age \pm standard deviation (SD) 45.93 ± 18.69 years. Number of attempts was clinically significant because out of 120 patients 91 were successful from the first attempt with p value= 0.186, in 34(37.4%) patients the cream was applied. EMLA cream was significantly more effective in reducing the intravenous cannulation pain (p value = 0.018) comparing to ethyl chloride spray and no treatment. Conclusion: The study indicates that EMLA cream provided more effective analgesia in minimizing the venipuncture pain in adult with successful cannulation from the first attempts comparing to ethyl chloride spray and no treatment.

Keywords: Comparing, Effectiveness, EMLA Cream 5%, Ethyl Chloride Spray, Pain, Intravenous Insertion, Adult, Elective Surgeries.

Introduction / Background

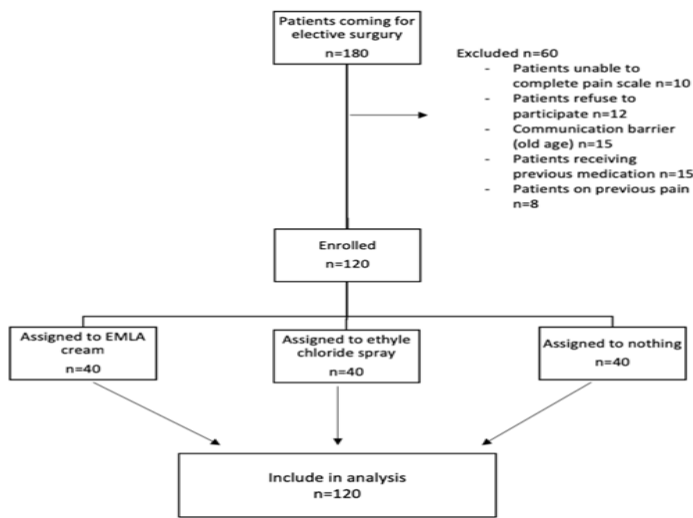
Intravenous cannulation (IV) is usually the most common medical procedure that anesthesia technologist performs on patients presenting for procedures that require administration of anesthesia or fluids replacement, and it is quit painful procedure. Unfortunately, there is no measure taken for reducing the IV pain, while there are so many studies showed that it is a painful procedure ^[1]. Despite the fact that causing unnecessary pain during any medical procedure is not acceptable for a human being, inadequate pain relief may also increase anxiety about future treatment and be remembered as a bad experience ^[2]. Therefore, health providers could use many different techniques of topical anesthesia to reduce the pain associated with IV cannulation; EMLA cream and Ethyl Chloride spray are the most common techniques. Moreover, EMLA is a cream that contains eutectic mixture of 2.59 % lidocaine and 2.59 % prilocaine. And it can used to desensitize intact skin for superficial minor procedures such as cannulation. A thick layer of cream is applied to intact shaved skin in the area to be anesthetized and covered with an occlusive dressing ^[3]. Ethyl chloride spray is a topical aerosol anesthetic skin refrigerant that creates a cooling effect on the surface of the epidermis followed by immediate evaporation. The coldness created by the spray decreases the nerve conduction which causes delaying in the body's normal respond to pain. Moreover, the spray is to be applied to venipuncture site continuously for 3-7 seconds from a distance of 3-9 inches. And the effects last up to one minute ^[4]. These techniques of topical anesthesia for IV cannulation have been used in clinical practice, especially for children. Relevant reviews, editorial and surveys on this topic were found ^[5-8]. Additionally, in King Abdul-Aziz Medical City (KAMC) KSA-Riyadh somehow no such practice exists. In another survey done by Mary Bond in United Kingdom (UK) showed that more than half of the

health providers did not use any topical anesthesia before IV cannulation ^[2]. Another survey was done by William D. Norris conducted in 71 hospitals in United Kingdom (UK) found that 35% of the health providers occasionally used topical anesthesia for IV cannulation ^[8]. Many studies showed that EMLA cream is often used for children, but it is rarely offered in adult patients ^[9-10]. And in one study done by Hallén.B EMLA cream was rubbed for five minutes on the skin before venipuncture and was found to have less pain compared with patients without EMLA cream application, however when compared to patients who had received EMLA cream on skin for one hour, the group rubbed for five minutes had more pain ^[11].

In another study, it was found that EMLA cream if applied for less than 30 minutes had little difference between trial and control groups ^[10-11]. The use of ethyl chlorid helpful in reducing the pain of IV cannulation ^[12-16]. Thus, the main purpose of this study is to examine the effectiveness of two different pain relief techniques which are EMLA cream 5% and Ethyl Chloride spray in reducing the pain that associated with IV cannulation to figure out which one is more effective in adult patients. Examining the effect of topical anesthesia on the number of attempts, comparing the onset of action for EMLA cream and Ethyl Chloride spray and examining the complication of them are the specific obj e spray had also been found to

Methodology

After obtaining the approval from the Institutional Review Board (IRB) this observational cross-sectional study was conducted in King Abdul-Aziz Medical City (KAMC) KSA-Riyadh, which is under the umbrella of Ministry of National Guard Health Affairs (NGHA). Specifically, in the holding area for surgery theaters, the area where the patients are received for elective surgeries to have the IV and sign the anesthesia and procedure consents.



According to the data from NGHAs on an average 2000 adult patients with peripheral venous cannula are there per month. With a margin of error 5% and 95% confidence level the minimum required sample size calculated as 179 and rounded to 180. Additionally, any adult patient coming for elective surgery was randomly selected except patients who didn't meet the study inclusion criteria. And out of 180 patients, 60 were excluded for different reasons (flow chart). At the end, 120 patients were enrolled after obtaining informed consent by using convenience sampling technique and randomly allocated into three groups.

1. Local anesthetic cream (EMLA 5%) group
2. Ethyl Chloride spray group
3. No treatment (comparison group)

Following to the King Abdul-Aziz Medical City (KAMC) guidelines, insertion of IV and applying of EMLA cream or ethyl chloride spray was done by an expert anesthesia technologist. In addition, the EMLA cream and ethyl chloride spray was applied to the patients due to the anesthesia technologist decision and the patient's need (appendix 1.1). The time of applying the agents vary from one to another. For EMLA cream 5%, it was applied before the cannulation for 5-60 minutes and covered by tegaderm. In contrast, ethyl chloride spray was sprayed for 1- 15 seconds before cannulation. After the anesthesia technologist performs a successful IV cannula, the research

team members assessed the pain level for each patient by using visual analog pain scale (VAS) 0 – 100 mm by asking the patients or show them the scale and they point at the level they feel. The scores on VAS were divided into no pain, mild pain, moderate pain, severe pain and extreme pain. Collecting the patient's variables was done by using a data collection sheet, which includes the patient's gender, age and pain level. Also, it will include the applying duration, site of insertion, numbers of attempts, the type of local anesthetic technique and if there is any complication with the local anesthetic (appendix 1.2) The collected data was entered by using Excel, and after that it was analyzed through Statistical Package for the Social Science (SPSS version 22), and tested by analysis of variance (ANOVA) and Chi-square test. Mean and standard deviation (SD) was used for continuous and normally distributed variables. And for the continuous variables but not normally distributed, median and IQR was used. Moreover, percentage (frequency) was used for categorical variables.

Results

The study aimed to find out the most effective techniques in reducing the pain associated with IV cannulation. And the study result presented in this section, out of 120 patients, 65(54.2%) were females and the mean age \pm standard deviation (SD) is 45.93 ± 18.69 years which are presented in

Table 1: Demographic details of the participants

The characteristics of topical anesthesia were summarized in The table shows that 40(33.3%) patients each been giving cream, spray and nothing before the cannulation. IV cannula was inserted in the left hand for the majority of the sample size which presented in 88(73.3%) out of 120(100%). Meanwhile, the rest of the patients were cannulated in the right hand 32(73.3%). Also, it is clear that most of the patients had a successful cannulation from the first attempt shown in 91(75.8%).

Table 2: Characteristics of topical anesthesia used

Regarding to the severity of pain which given in (Fig.1), it was clear that the majority of patients had mild pain 44(36.7%) which represent the first sector. In the second sector, 36(30%) patients felt no pain. And the third sector composed of 26(21.7%) patients who experienced moderate pain. For fourth sector, 11(9.1%) patients were exposed to sever pain. The last sector displays patients who suffered from extreme pain 3(2.5%).

Fig 1: Pie diagram showing the severity of pain in the subjects. The figure below (Fig.2) shows the relation between the mean score and the different techniques by using analysis of variance (ANOVA) test. Patients who received nothing or ethyl chloride spray before the IV cannulation had the highest pain score comparing with patients who received EMLA cream (16.03 ± 23.60) which present the lowest pain score.

Fig2: Mean pain score and the Type of local anesthesia.

The relation between different techniques and other variables were statistically tested using Pearson chi square test which shows that gender and site of insertion were not statistically significant ($P \text{ value} > 0.05$). Number of attempts was clinically significant because out of 120 patients 91 were successful from the first attempt, in 34(37.4%) patients the cream was applied (table 3).

Table 3: Type of local anesthesia & other variables

The relation between the time of applying topical agents in seconds and the severity of pain is presented in (Table 4). And according to the table, it is clear that they are not statistically significant. Moreover, the EMLA cream shows a negative correlation because whenever the time of applying increases the level of pain decreases. On the contrary, ethyl chloride spray shows a positive correlation which means when the time of applying increases the level of pain also increases.

Table 4: Relation between severity of pain and time (in seconds) for applying the agents.

Discussion

This observational cross-sectional study has compared the use of two different techniques in reducing the pain associated with IV cannulation for adult patients undergoing elective surgeries in National Guard Health Affairs (NGHA), and the two techniques include applying EMLA cream and Ethyl Chloride spray before cannulation. The result of this study shows that EMLA cream provided more effective analgesia in minimizing the venipuncture pain in adult with successful cannulation from the first attempts comparing to ethyl chloride spray and no treatment. Of note, EMLA cream was not associated with any serious adverse events or with a reduction in first attempt success rates at IV cannulation. NGHA is one of the main hospitals in Riyadh, Saudi Arabia, with an average of 2000 patient with IV cannulation per month which help in the data collection process for this research. In addition, EMLA cream and ethyl chloride spray were provided by NGHA which was appropriate. In this study, many factors considered as some limitations and one of them is that the sample size was reduced because of the high excluded number of patients. Moreover, the variety of techniques for cannula insertion could affect the pain level. To reduce the bias, patients were asked about the level of pain after the practitioner who inserted the IV cannula leaves, because some of the patients are too embarrassed to tell the real answer if the level of pain was too high.

Our finding in this research was similar to Gülperi Çelik study^[17] which used visual analogue scale of 100mm to assess the pain level, and its result was that EMLA cream is more effective than ethyl chloride or no treatment. Additionally, McPhail et al study^[18] found that EMLA is effective in reducing pain and alleviating anxiety associated with cannulation. Despite the advantages of EMLA that

was found in this study, other studies showed some disadvantages, one of these disadvantages is causing allergic reactions [18-19]. Moreover, for EMLA cream to be fully effective it needs to be applied before IV insertion at least

45 to 60 minutes, which is considered as a long time for patients and practitioners comparing with ethyl chloride spray (30s) [10-11]. Ethyl chloride spray is claimed to offer several advantages over other pain relief techniques. One of the advantages is providing adequate pain relief during venipuncture, and it is less time consuming because of its rapid effect which is suitable for the practitioners and shortens the time of waiting for the patient in the holding area [20]. In spite of the advantages of ethyl chloride spray, some studies showed disadvantages, the duration of the effect lasts for a very short time [21] as well as it causes some patients to feel the cooling pain. In contrast, the patients of this study didn't feel any pain [18]. And the cooling effect may lead to vasoconstriction in some patient, which may lead to several cannulation attempts and increase the pain level [15]. According to the results of this study, it was clear that the rate of successful attempts from the first time decreased with the ethyl chloride spray. John M study shows that applying cold EMLA cream may also cause vasoconstriction only at the beginning of rubbing it, but later when it's warmed to meet the body temperature, the vasoconstriction effect will disappear [19].

Conclusion / Recommendation

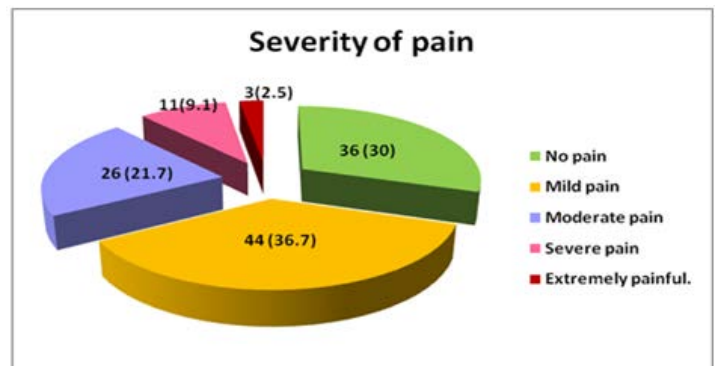
Although many studies showed the effectiveness of EMLA cream and ethyl chloride spray in reducing the pain associated with cannulation, most of them were leaning towards children. On the other hand, there are not enough studies for adults even though they feel pain. The results of this study show that using EMLA cream and ethyl chloride spray was effective for reducing pain associated with IV cannula insertion. In addition, these results should be

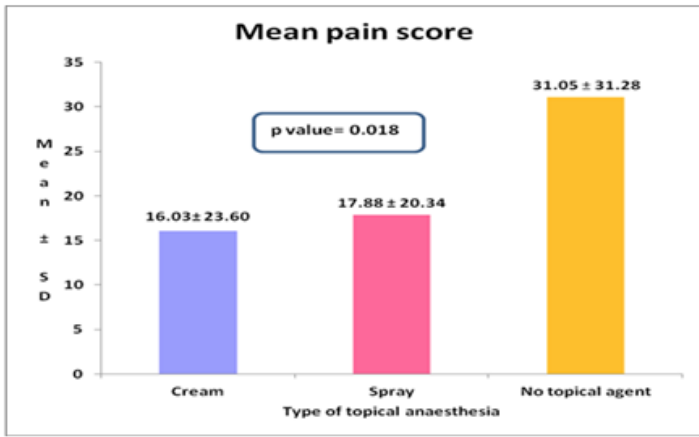
applied in every medical field where the patients require IV cannula not only in patients who undergoing elective

Variable	Frequency (Percentage)
Gender	
Male	55 (45.8)
Female	65 (54.2)
Age (mean ± SD) in years	45.93 ± 18.69
Total	120 (100)

surgeries. Further studies should be conducted for adult patients in different institution to compare between EMLA cream and ethyl chloride spray with other topical agent, involving larger sample size to show the real effect of different techniques for topical anesthesia before IV insertion.

Variable	Frequency (Percentage)
Type of local agent	
Cream	40 (33.3)
Spray	40 (33.3)
Without local agent	40 (33.3)
Insertion site	
Left hand	88 (73.3)
Right hand	32 (26.7)
Number of attempts	
Successful from the first time	91 (75.8)
Not successful from the first time	20 (24.2)





Variable	Type of local anaesthesia				Chi square value	P value
	Cream	Spray	No local anaesthesia	Total		
No. (%)						
Gender					0.269	0.874
Male	19 (47.5)	19 (47.5)	17 (42.5)	55 (45.8)		
Female	21 (52.5)	21 (52.5)	23 (57.5)	65 (54.2)		
Total	40 (100.0)	40 (100.0)	40 (100.0)	120 (100.0)		
Site of insertion					1.364	0.506
Left hand	32 (80.0)	28 (70.0)	28 (70.0)	88 (73.3)		
Right hand	8 (20.0)	12 (30.0)	12 (30.0)	32 (26.7)		
Total	40 (100)	40 (100)	40 (100)	120 (100)		
Number of attempts					3.365	0.186
Successful from the first time	34 (37.3)	30 (33.0)	27 (29.7)	91 (100.0)		
Not successful	6 (20.7)	10 (34.5)	13 (44.8)	29 (100.0)		

Type of topical agent	Severity of pain	N	Mean ± SD (in sec)	Test used	Mean rank	Test statistic	P value	
Cream	No pain	18	2034 ± 979.40	Kruskal Wallis	23.22	Chi square= 4.567	0.335	
	Mild pain	12			16.79			
	Moderate pain	7			18.29			
	Sever pain	2			30.50			
	Extremely painful	1			11.50			
	Total	40						
Ethyl Chloride Spray	No pain	11	7.20 ± 3.89	Kruskal Wallis	18.18	Chi square= 0.879	0.830	
	Mild pain	16			21.00			
	Moderate pain	10			22.30			
	Sever pain	3			20.33			
	Total	40						

References

- Nuttall GA, Barnett MR, Smith RL, Blue TK, Clark KR, Payton BW. Establishing intravenous access: a study of local anesthetic efficacy. *Anesth Analg* [Internet]. 1993 Nov [cited 2018 Mar 14];77(5):950–3. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/8214733>
- Bond M, Crathorne L, Peters J, Coelho H, Haasova M, Cooper C, et al. First do no harm: pain relief for the peripheral venous cannulation of adults, a systematic review and network meta-analysis. *BMC Anesthesiol* [Internet]. 2016 [cited 2018 Apr 29];16(1):81.

Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27716082>

- Thomas JA (John A, Lerche P. Anesthesia and analgesia for veterinary technicians [Internet]. [cited 2018 May 8]. Available from: <https://books.google.com.sa/books?id=gxnYCwAAQB-AJ&pg=PA217&lpg=PA217&dq=emla+cream+analgesia+E-book&source=bl&ots=uZfPN5mIqU&sig=gmDEBWR7hRbZvi8IbBzSulSaqBQ&hl=ar&sa=X&ved=0ahUKEwjawa6LqtrZAhWEUhQKHetDCZEQ6AEIQzAE#v=onepage&q=emla cream analgesia E-book&f=false>
- Conforti BSN K, Dougherty BSN B, Reed BSN H. Ethyl Chloride Use for Pain Reduction during Pediatric Venipuncture. [cited 2018 May 8]; Available from: http://www.pennstatehershey.org/documents/1699942/10309813/GN2012J_EthylChlorideUsePainReductionDuringPedVeni/44e8ea83-95b4-4b2c-8bbf-094f074cc0d6
- Hogan M-E, Smart S, Shah V, Taddio A. A Systematic Review of Vapocoolants for Reducing Pain from Venipuncture and Venous Cannulation in Children and Adults. *J Emerg Med* [Internet]. 2014 Dec [cited 2018 Mar 14];47(6):736–49. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/25168120>
- Moore A, Straube S, McQuay H. Minimising pain during intravenous cannulation. *BMJ* [Internet]. 2009 Feb 10 [cited 2018 Mar 14];338:a2993. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/19208702>
- Sado DM, Deakin CD. Local anaesthesia for venous cannulation and arterial blood gas sampling: are doctors using it? *J R Soc Med* [Internet]. 2005 Apr 1 [cited 2018 Mar 14];98(4):158–60. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/15805556>
- Norris WD. The use of local anaesthesia in peripheral venous cannulation: current practice of junior doctors. *J R Nav Med Serv* [Internet]. 2002 [cited 2018 Mar 14];100(1):1–4.

- 14];88(2):62–4. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/12500485>
9. Hallén B, Uppfeldt A. Does lidocaine-prilocaine cream permit painfree insertion of IV catheters in children? *Anesthesiology* [Internet]. 1982 Oct [cited 2018 Apr 29];57(4):340–2. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/7125278>
10. Ehrenström-Reiz G, Reiz S, Stockman O. Topical anaesthesia with EMLA, a new lidocaine-prilocaine cream and the Cusum technique for detection of minimal application time. *Acta Anaesthesiol Scand* [Internet]. 1983 Dec [cited 2018 Apr 29];27(6):510–2. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/6364678>
11. Hallén B, Olsson GL, Uppfeldt A. Pain-free venepuncture. Effect of timing of application of local anaesthetic cream. *Anaesthesia* [Internet]. 1984 Oct [cited 2018 Apr 29];39(10):969–72. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/6496911>
12. Harrison N, Langham BT, Bogod DG. Appropriate use of local anaesthetic for venous cannulation. *Anaesthesia* [Internet]. 1992 [cited 2018 Apr 29];47(2):10–21. Available from: <https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1365-2044.1992.tb02120.x>
13. Langham BT, Harrison DA. Local anaesthetic: does it really reduce the pain of insertion of all sizes of venous cannula? *Anaesthesia* [Internet]. 1992 Oct 1 [cited 2018 Apr 29];47(10):890–1. Available from: <http://doi.wiley.com/10.1111/j.1365-2044.1992.tb03157.x>
14. Hijazi R, Taylor D, Richardson J. Effect of topical alkane vapocoolant spray on pain with intravenous cannulation in patients in emergency departments: randomised double blind placebo controlled trial. *BMJ* [Internet]. 2009 Feb 10 [cited 2018 Apr 30];338:b215. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/19208703>
15. Farion KJ, Splinter KL, Newhook K, Gaboury I, Splinter WM. The effect of vapocoolant spray on pain due to intravenous cannulation in children: a randomized controlled trial. *Can Med Assoc J* [Internet]. 2008 Jun 12 [cited 2018 Mar 14];179(1):31–6. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/18591524>
16. Robinson PA, Carr S, Pearson S, Frampton C. Lignocaine is a better analgesic than either ethyl chloride or nitrous oxide for peripheral intravenous cannulation. *Emerg Med Australas* [Internet]. 2007 Oct [cited 2018 Mar 14];19(5):427–32. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/17919215>
17. Çelik G, Özbek O, Yilmaz M, Duman I, Özbek S, Apiliogullari S. 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* [Internet]. 2011 [cited 2018 Dec 3];8(7):623–7. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/22022215>
18. McPhail S. Hemodialysis needles can be pain free: use of a topical anaesthetic cream. *J CANNT* [Internet]. 1992 [cited 2018 Dec 3];2(4):19–20. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/1467067>
19. Burke SD, Vercler SJ, Bye RO, Desmond PC, Rees YW. Original Research: Local Anesthesia Before IV Catheterization. *AJN, Am J Nurs* [Internet]. 2011 Feb [cited 2018 Dec 3];111(2):40–5. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/21270583>