

The Comparison of Effectiveness Between Eutectic Mixture of Local Anesthetics (EMLA) Cream and Ethyl Chloride Spray on Pain

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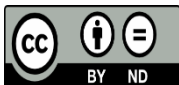


Keywords:

EMLA cream, ethyl chloride spray, pain

ABSTRACT

Pain is a condition that is felt by a person subjectively, in which everyone has a different level of pain. Several studies show that there are still many complaints of pain felt by some people, which are caused by needles. The purpose of this paper is to determine the effectiveness of EMLA and ethyl chloride spray to reduce pain caused by needles. This study is a literature review using data from various sources such as books, websites, journals and others. The result shows that neither EMLA nor ethyl chloride spray had a significant difference in reducing pain intensity. Ethyl chloride spray has rapid onset of action and short duration of action. Ethyl chloride spray also rarely causes allergic reactions and has very little systemic effect. Meanwhile, EMLA has a slow onset but it has long duration and also a deeper anesthetic effect than ethyl chloride spray. The conclusion of this study is that EMLA and ethyl chloride spray both have the same effectiveness to reduce local pain on the skin, but ethyl chloride spray has a fast onset of action so it is more suitable for procedures that require a shorter preparation time compared to EMLA which has a slower onset of action.



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1. INTRODUCTION

Pain is a condition of discomfort that is subjective in nature for each individual, since everyone has a different scale or level of pain tolerance and only the person can describe the pain they are experiencing. Fear and anxiety often arise in children undergoing a circumcision, in which 5% of these children feel fear toward the syringe needle. Fear of being punctured may be associated with their previous experiences, in which they felt pain during an injection [1].

Several patients reject spinal anesthesia due to phobia against needles. The main reason is pain caused by the needle, and it remains the issue in the practice of anesthesia. This issue affects nearly 10% of the population. Based on studies, 28% of obsgyn patients reject regional anesthesia due to phobia against needle. Phobia against needle and pain can also cause procedural difficulties, thus, affecting the quality of the spinal

anesthesia and may cause syncope [2].

In 2020, a study was conducted on 10 patients who visited the Emergency Department of X Hospital in Denpasar, aged between 20 to 50 years. These patients underwent intravenous line insertion, followed by the assessment of pain intensity using the Numeric Rating Scale. The results showed that 3 individuals experienced mild pain with a score of 2-3, while 7 individuals reported moderate pain with a score of 4-6. The conclusion drawn from this study is that intravenous line insertion can induce acute pain, leading to discomfort and psychological distress among patients [3].

A study conducted in Germany in 2018 demonstrated that pain during lumbar puncture can be significantly reduced through the administration of local anesthesia, both with EMLA cream and local infiltration of prilocaine anesthesia. A research conducted in Indonesia in 2018 on patients undergoing spinal anesthesia before brachytherapy procedures showed a statistically significant reduction in pain levels among subjects who received EMLA [4].

A study conducted on a group of patients undergoing venous puncture for hemodialysis procedures demonstrated that the application of EMLA cream or ethyl chloride spray effectively reduces pain during needle penetration when compared to a placebo [5].

There are several methods to alleviate needle injection pain, such as using the eutectic mixture of local anesthesia (EMLA) cream and ethyl chloride spray. EMLA cream is a combination of 2.5% lidocaine and 2.5% prilocaine in a cream form, enabling penetration into deeper skin layers. EMLA provides an analgesic effect that can penetrate the skin to a depth of 3 mm after 60 minutes of application and 5 mm after 120 minutes [6]. On the other hand, the commonly used cold spray is vapocoolant spray containing ethyl chloride. Ethyl chloride spray (C_2H_5Cl) is a colorless liquid characterized by high volatility and flammability. It is applied to the skin through spraying, resulting in local anesthesia with superficial freezing caused by rapid evaporation [3].

Based on these issues, we were interested in analyzing the effectiveness of eutectic mixture of local anesthetics (EMLA) cream and ethyl chloride spray in managing pain.

2. Methods

2.1 Design

This study used a literature review design.

2.2 Data Sources

This study collected previous study results from official journal websites such as from Google Scholar, NCBI, Elsevier, etc.

Data sources used by the author are relevant to the problem formulation. The data sources comprise of journal articles and websites that adhere to both national and international standards, thereby ensuring their credibility. The keywords employed in the article search were Eutectic Mixture of Local Anesthetics (EMLA) cream, Ethyl chloride spray, and pain."

The inclusion criteria for selecting appropriate journals include availability in both English and Indonesian languages, full-text access, and publication within the last 10 years. Journals were excluded if they were

literature reviews, meta-analyses, encyclopedias, and unpublished research such as theses, dissertations, conference abstracts, and others.

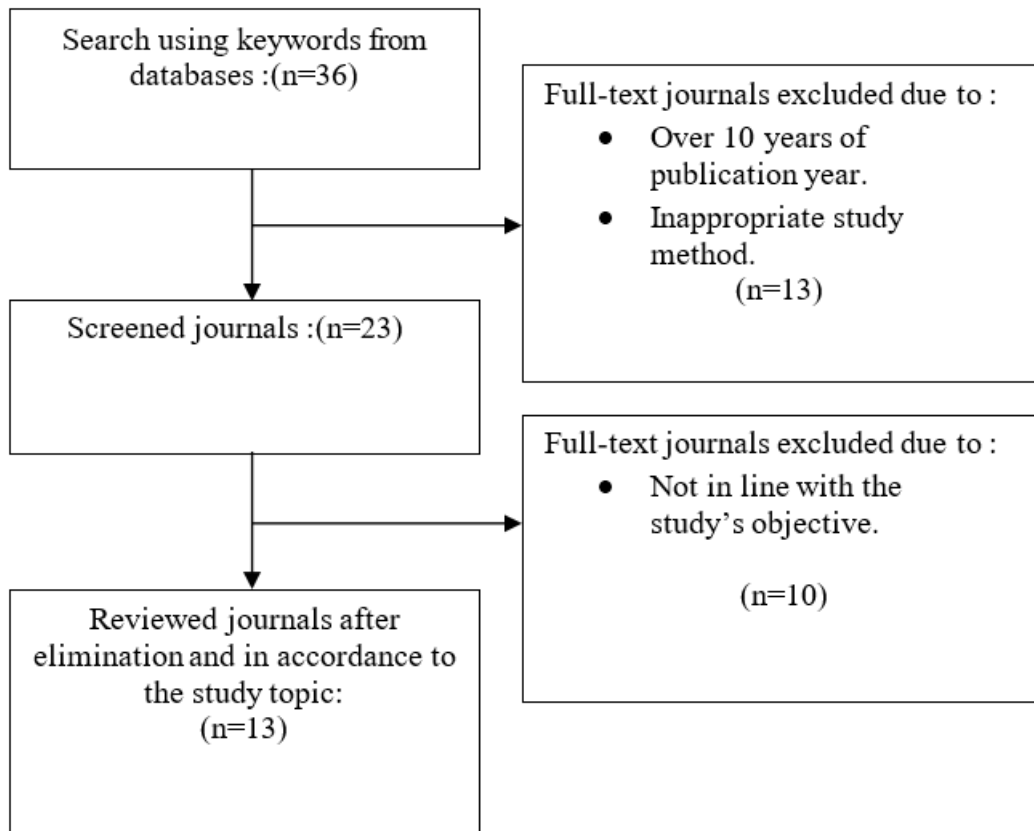


Figure 1. The Study's Flowchart.

2.3 Data Analysis Method

The data analysis method used in this study was the Critical Appraisal method.

3. Results

Author	Title	Results	Conclusion
[7]	Comparison between vapocoolant spray and eutectic mixture of local anesthetics cream in reducing pain during spinal injections.	Pain intensity data using NPRS and patient's movement in both groups showed no significant difference between the two groups.	No significant difference in reducing pain intensity between EMLA and vapocoolant spray.
[8]	Comparing the effectiveness of vapocoolant spray and lidocaine/procaine cream in reducing pain of intravenous cannulation: a randomized clinical	Most of the subjects in the control group felt severe pain. The EMLA group mostly felt very mild pain, most vapocoolant group felt moderate pain. The mean difference between EMLA and vapocoolant was 2.45 and the difference between EMLA and control was 6.35. The mean difference of pain after vapocoolant spray compared to	EMLA reduces pain intensity 2.45 times higher compared to ethyl chloride spray.

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	trial	the control group was 3.90.	
[9]	Comparison of the effects of vapocoolant spray and topical anesthetic cream on pain during needle electromyography in the medial gastrocnemius	The mean VAS score following electromyography was 52.9 in the control group, 42.4 in the EMLA group, and 31.9 in the vapocoolant spray group. There was no significant difference between EMLA and control group. Meanwhile, vapocoolant spray significantly reduced pain intensity.	The VAS score was between 0-10, in which 10 is the same with 100 mm. The mean VAS due to EMLA was 42.4. The mean VAS with the vapocoolant spray was 31.9.
[3]	The comparison between EMLA cream and ethyl chloride spray in reducing pain during intravenous line insertion	The results in the 40 subjects with EMLA during intravenous line insertion showed that most subjects had mild pain (33 subjects/82.5%), and moderate pain in seven subjects (17.5%). In the 40 subjects with ethyl chloride spray during intravenous line insertion, most subjects had mild pain (26 subjects/65%), and moderate pain in 14 subjects (35%).	EMLA showed a significant result in reducing pain intensity by causing mild pain compared to ethyl chloride spray. The ethyl chloride spray has two-folds efficacy in reducing moderate pain. Meanwhile, EMLA was more effective in reducing mild pain compared to the ethyl chloride spray, with a 20% difference.
[5]	The effectiveness of EMLA 5% compared to ethyl chloride spray in reducing pain during epidural needle insertion	At an injection depth of 0.5-1 cm, VAS scores for the EMLA group were mostly in the mild category (6 respondents), while the ethyl chloride group was mostly in the moderate category (6 respondents), and lidocaine group was mostly in the mild category (6 respondents). On the other hand, at a depth of 1-4 cm, VAS scores for the EMLA group were mostly in the moderate category (5 respondents), the ethyl chloride group was mostly in the severe category (6 respondents), and the control group was mostly in the moderate category (4 respondents).	The difference in pain intensity reduction between the use of EMLA and ethyl chloride was not statistically significant. However, EMLA demonstrated a superior effect compared to ethyl chloride spray in reducing pain levels during injection procedures, both at depths of 0.5-1 cm and 1-4 cm
[10]	Comparative efficacy of EMLA cream and ethyl chloride spray for reducing the venipuncture pain during intravenous cannulation	The mean VAS score in the EMLA group was 2.98 (mild pain), while the ethyl chloride spray group was 4.18 (moderate pain).	EMLA was more significant in reducing pain intensity compared to ethyl chloride spray.
[11]	Clinical comparison of EMLA cream and ethyl chloride spray application for pain	In Group 1, the average VAS score for the ethyl chloride side was 3.20, and for the control side was 7.26. In Group 2, the average VAS score for	Ethyl chloride alcohol was more significant in reducing pain, with a comparison of VAS EMLA 6.80 and ethyl chloride 2.93.

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	relief of forehead botulinum toxin injection	the EMLA side was 4.20, and for the control side was 7.66. In Group 3, the average VAS score for the EMLA side was 6.80, and for the ethyl chloride side was 2.93. Both EMLA and ethyl chloride significantly reduced pain and improve patient comfort.	
[12]	Comparative study of topical ethyl chloride spray & eutectic mixture of lignocaine and prilocaine cream for management of pain in minor surgical procedure	The average VAS score during the procedure (T ₀) in the ethyl chloride group was 3.36, and in the EMLA group was 2.12. The average VAS score after 30 minutes of the procedure (T ₃₀) in the ethyl chloride group was 6.64, and in the EMLA group was 5.44.	The comparison of pain intensity (VAS) between EMLA and ethyl chloride was 2.12 versus 3.36 at T ₀ , and 5.44 versus 6.64 at T ₃₀
[13]	The effect of eutectic mixture of local anesthetics (EMLA) on pain during spinal needle insertion.	The mean pain score in the EMLA group was 1, while the placebo group was 4.	EMLA was effective in reducing pain intensity.
[14]	The effect of ethyl chloride spray on pain level in hemodialysis patients with arteriovenous fistula insertion in the Utama Bali Husada Cipta Chanti Clinic.	The level of pain before the administration of ethyl chloride spray in 27 respondents was moderate pain, with a level of 5 on the scale (39.1%). Following the administration of ethyl chloride spray, there were 30 respondents with a mild pain level of 3 on the scale (43.5%).	There was reduced pain intensity from ethyl chloride (VAS 5 to 3).
[15]	Investigation of the effect of EMLA cream, lidocaine spray, and ice pack on the arteriovenous fistula cannulation pain intensity in hemodialysis patients.	The mean VAS score in the EMLA group was 2.8, lidocaine spray 4.22, ice pack 5.38, control 7.45. EMLA significantly reduced pain compared to lidocaine spray and ice pack.	EMLA significantly reduced pain compared to lidocaine spray and ice pack.
[16]	Improved pain scale during intravenous line insertion with EMLA in preschool children in the emergency department.	In the EMLA group, 20 subjects (66.7%) had severe pain and 10 subjects (33.3%) had moderate pain. In the control group, 28 subjects (93.3%) had severe pain and 2 subjects (6.7%) had moderate pain.	EMLA significantly reduced severe pain intensity for 28.6%.
[17]	Prospective, randomized, double-	The median of the NRS score for pain after venous puncture was 3 (1.2-5) in	Vapocoolant spray effectively reduced pain, based on the NRS

Author	Title	Results	Conclusion
	blind controlled trial comparing vapocoolant spray vs placebo spray in adults	the placebo group and 1 (0-3) in the vapocoolant group.	score from 3 to 1.

4. Discussion

Based on several studies, both EMLA and ethyl chloride spray demonstrate equal effectiveness in reducing pain intensity. There is no significant difference between them in terms of pain reduction. However, when compared to placebo/control, both the EMLA and ethyl chloride spray groups showed significant differences from the placebo/control group. A study by [8] showed that both EMLA and ethyl chloride spray significantly reduce pain in patients undergoing intravenous cannulation.

Ethyl chloride spray offers the advantage of a rapid onset compared to EMLA. This is attributed to the volatile nature of ethyl chloride, which leads to a quick decrease in temperature in the sprayed area, resulting in the slowing of nerve conduction from C fibers and A-delta fibers in the peripheral nervous system, thereby reducing the central nervous system's capacity to perceive pain. Additionally, ethyl chloride spray rarely induces allergic reactions and has minimal systemic effects. A drawback of using ethyl chloride spray is its very short duration of analgesic effect, lasting less than 60 seconds before the temperature in the sprayed area returns to normal, necessitating reapplication when the procedure is not yet complete. There is also a possibility of frostbite occurring at the sprayed location [18]. [17] reported that compared to placebo spray, ethyl chloride spray has a highly significant effect in reducing pain intensity in patients undergoing venous puncture.

One limitation of EMLA is its slow onset, taking 60-120 minutes to achieve effective results. This is due to EMLA needing to penetrate the layers of the skin to become active. EMLA functions on sensory nerve endings by inhibiting the formation and conduction of nerve impulses through sodium channels, preventing depolarization. EMLA can be used under an occlusive dressing, which slightly accelerates its onset and enhances penetration ability. Moreover, EMLA carries risks of allergy and methemoglobinemia, making it necessary to avoid drugs that induce methemoglobinemia [19]. On the other hand, EMLA offers several advantages, including a prolonged working duration of approximately 1-5 hours. It also provides deeper analgesic effects compared to ethyl chloride spray. The analgesic effect reaches a depth of 3 mm after 60 minutes of use and 5 mm after 120 minutes of use. A study by [5] reported that VAS scores for injections at depths of 1-4 cm were lower in the EMLA group compared to the ethyl chloride spray group. In terms of cost, EMLA is more affordable than ethyl chloride spray.

Due to its rapid onset and short duration, ethyl chloride spray is suitable for procedures involving needle insertion, such as immunization, venipuncture, hemodialysis punctures, intravenous cannulation, spinal anesthesia, botulinum toxin injections, and others. On the other hand, EMLA, with its longer duration and deeper level of analgesia compared to ethyl chloride spray, is applicable for certain minor surgical procedures such as circumcision, split-skin grafts, molluscum contagiosum curettage, wart cauterization, laser procedures like laser hair removal, and more. However, EMLA can also be used for procedures involving needle insertion [19], [20]. Both EMLA and ethyl chloride spray provide benefits in reducing pain intensity, consequently lowering patient anxiety levels and enhancing patient satisfaction. For some individuals, the fear of needles might not arise when undergoing these procedures in the future. The ease of performing procedures like spinal anesthesia is also improved since patients exhibit reduced movement due to the pain caused by needle insertion, along with relatively stable vital signs before undergoing spinal anesthesia [6].

5. Conclusion

Both EMLA and ethyl chloride spray have equal effectiveness in reducing local skin pain. However, ethyl chloride spray demonstrates a rapid onset, making it more suitable for procedures requiring shorter preparation times compared to EMLA, which has a longer onset time. Patients need to wait up to 60 minutes before injection after applying EMLA cream, whereas they only need to wait ten seconds before injection after applying ethyl chloride spray.

Suggestions

Through this study, medical personnel are expected to be able to reduce pain before procedures, particularly those involving needle insertion, by employing EMLA cream and ethyl chloride spray. This is intended to reduce patient anxiety levels and help patients undergo procedures without fear upon subsequent visits. Moreover, this approach can prevent procedural failure caused by patients unable to tolerate the experienced pain.

6. References

- [1] Dikaprio MF, Romdhoni MF, Riyanto R, Susiyadi. Reducing visual analog scale (VAS) in circumcision patient by the additional of topical anesthesia agent in local anesthesia procedures. *Indonesian Journal of Pharmacology and Therapy*. 2021;2(2):92-96.
- [2] Inangil G, Cansız KH. The effect of ShotBlocker on pain and patient satisfaction for spinal anesthesia: a randomized trial. *Pain Physician Journal*. 2021;24:E31-E36.
- [3] Ratnaningsih DP, Wijaya IPA, Kusuma PW. Perbedaan EMLA cream dan ethylchloride spray untuk menurunkan nyeri dalam pemasangan infus. *Jurnal Keperawatan Sriwijaya*. 2021;8(2):27-38.
- [4] Massoth C, Weidlich S, Popping DM, Gurlit S, Mollmann M, Wenk M. Effects of local skin anesthesia on pain during lumbar puncture. *Journal Anesthesiol Crit Care*. 2017;1(1):1–5.
- [5] Purnomo HD, Dewi FH, Citra AD. Efektivitas pemberian EMLA 5% dibanding dengan spray ethyl chloride spray untuk mengurangi nyeri pada suntikan jarum epidural. *Jurnal Anestesi Perioperatif*. 2021;9(3):168-73
- [6] Soenarjo, Jatmiko HD. *Anestesiologi*. Semarang: PERDATIN; 2015.h.94-114.
- [7] Firdaus R, Sukmono B, Melati AC, Marzaini BD. Comparison between vapocoolant spray and eutectic mixture of local anesthetics cream in reducing pain during spinal injections. *Anesthesiology Research and Practice*. 2018.h.1-5. Diunduh dari <https://doi.org/10.1155/2018/5050273>
- [8] Dalvandi A, Ranjbar H, Hatamizadeh M, Rahgoi A, Bernstein C. Comparing the effectiveness of vapocoolant spray and lidocaine/procaine cream in reducing pain of intravenous cannulation: A randomized clinical trial. *American Journal of Emergency Medicine*. 2017.h.1-5. Diunduh dari <http://dx.doi.org/10.1016/j.ajem.2017.02.039>
- [9] Moon YE, Kim SH, Choi WH. Comparison of the effects of vapocoolant spray and topical anesthetic cream on pain during needle electromyography in the medial gastrocnemius. *The American Congress of Rehabilitation Medicine*. 2013;94(1):919-24.

- [10] Ajjappa AK, Sagar SM, Surya HM. Comparative efficacy of EMLA cream and ethyl chloride spray for reducing the venipuncture pain during intravenous cannulation. *Indian Journal of Anesthesia and Analgesia*. 2021;8(3):311-315.
- [11] Irkoren S, Ozkan HS, Karaca H. A clinical comparison of EMLA cream and ethyl chloride spray application for pain relief of forehead botulinum toxin injection. *Annals of Plastic Surgery*. 2015;75(3):272-274.
- [12] Mourya SK, Khajotiya SL, Kachhawaha D. Comparative study of topical ethyl chloride spray & eutectic mixture of lignocaine and prilocaine cream for management of pain in minor surgical procedure. *International Journal of Science and Research*. 2019;8(9):1570-1573.
- [13] Putra YR, Taviando D, Bisri DY. Efek eutectic mixture of local anesthetics (EMLA) terhadap nyeri penyuntikan jarum spinal. *Jurnal Anestesi Perioperatif*. 2019;7(3):175-80.
- [14] Lisyawati NK, Wijaya IPA, Darmawan AAKN. Pengaruh pemakaian ethyl chloride spray terhadap tingkat nyeri pada pasien hemodialisis dengan insersi fistula arterio venous di klinik utama Bali Husada Cipta Chanti. *Jurnal Keperawatan Terapan*. 2020;6(1):74-83.
- [15] Mirzaei S, Javadi M, Eftekhari A, Hatami M, Hemayati R. Investigation of the effect of EMLA cream, lidocaine spray and ice pack on the arteriovenous fistula cannulation pain intensity in hemodialysis patients. *International Journal of Medical Research & Health Sciences*. 2018;7(2):51-57.
- [16] Hartini S. Penurunan skala nyeri pemasangan infus dengan EMLA pada anak prasekolah di ruang instalasi gawat darurat. *Jurnal Keperawatan dan Kesehatan*. 2015;1(4):29-38.
- [17] Mace SE. Prospective, randomized, double-blind controlled trial comparing vapocoolant spray vs placebo spray in adults. *American Journal of Emergency Medicine*. 2016;34: 798-8
- [18] Franko O, Stern P. Use and effectiveness of ethyl chloride for hand injections. *The Journal of Hand Surgery*. 2017; 42(3):175-181.
- [19] Sobanko JF, Miller CJ, Alster TS. Topical anesthetics for dermatologic procedures: a review. *Wiley Periodicals*. 2012;38(1):709-721.
- [20] Puri N, Talwar A. Anesthesia for dermatologic procedures and their complications. 2014;24(2):164-172.