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ORIGINAL RESEARCH

Comparative Evaluation of the Efficacy of Topical Anesthetics in Reducing Pain during Administration of Injectable Local Anesthesia in Children

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ABSTRACT

Introduction: Pain control is an integral part of modern dentistry. Needle injection of local anesthetic which is the commonest modality of pain control itself proves to be painful for the child. Hence, it is important for the pediatric dentists to resort to a pain free method of administering local anesthesia for a patient. Topical anesthetics have proven to reduce the pain experience during administration of local anesthetic injection. The aim of this study is to evaluate and compare the efficacy of two topical anesthetic agents—EMLA 5% cream (Eutectic mixture of local anesthetics—Lignocaine 2.5% and prilocaine 2.5%) and Benzocaine 20% gel in reducing the pain during administration of local anesthetic injection in children.

Materials and methods: EMLA 5% cream and Benzocaine 20% gel were used in the study. Children from mixed dentition age group between 6 and 9 years of age were selected. The two selected topical anesthetics were applied on buccal mucosa at two different appointments in a given child, following which the local anesthetic was administered on the test site. The pain responses of the child were evaluated using the Wong Baker Faces Pain Rating Scale. The results were then statistically analyzed using Mann-Whitney U-test.

Results: EMLA 5% cream was three times highly effective in pain reduction than Benzocaine 20% gel.

Conclusion: EMLA 5% cream is comparatively better than benzocaine 20% gel with regards to pain reduction during the administration of local anesthetic injection in children.

Keywords: Benzocaine, Eutectic mixture of local anesthetics (EMLA), Pain control, Topical anesthetic agents, Wong-Baker faces pain rating scale.

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INTRODUCTION

Delivery of dental care to a child has always been a challenge due to the emotional trait-dental anxiety which is often noticed. Dental anxiety is multifactorial complex phenomenon[1] which develops due to variable factors such as personality characteristics, cognitive level, peer influence, maternal anxiety, past negative experiences, etc. Such an emotional imbalance could be a significant barrier to seeking and receiving dental care, and can eventually manifest as non-cooperative behavior leading to hindrance in the dental care delivery. Amongst all the factors responsible for development of disavowed behavior during dental treatment the cardinal determinant is the unpleasant feeling triggered by nervous system generally referred as pain. Control of pain is one of the most important and challenging aspects of child behavior management. Children who undergo early painful experiences during dental procedures are likely to carry negative feelings toward dentistry into adulthood. Therefore, it is important to make every effort to minimize pain and discomfort during treatment.

The simplest and most effective method of reducing pain during dental procedure is via injectable local anesthesia. However, it is ironical that needle injection of local anesthetic which is the commonest modality of pain control, itself is a source of fear and anxiety for the child. Hence, it is important to resort to a pain free method of administering local anestheisa for a pediatric patient. Thus, there was always a constant search of tools for painless local anesthesia administration. Topical anesthetic agents have proven to be a boon in their attempts to painless dentistry. The ability of various topical anesthetics to penetrate the oral mucosa and produce anesthesia has been well-documented.[2,3] They act by blocking the transmission of signals from the terminal fibers of the sensory nerves and provide effective surface anesthesia for a depth of 2 to 3 mm.[4] This property of surface anesthesia effectively reduces the pain associated with needle penetration of the mucous membrane.

Various agents are available today for topical analgesia. Among the various topical anesthetic agents used, benzocaine is the most popularly used topical anesthetic agent which has rapid onset of action and excellent surface anesthetic

properties. The low water solubility and consequent slow absorption of benzocaine from the area of topical application not only prolongs anesthesia but also reduces its toxicity.[5] Eutectic mixture of local anesthetics (EMLA) which is a eutectic mixture of 2.5% lignocaine and 2.5% prilocaine is a newer topical anesthetic agent which was approved for medical applications. It was introduced into the anesthetic armamentarium in 1980 for dermal analgesia.[6] However, the cream has been found to possess a local anesthetic effect on oral mucosa also.[7] Since then, a number of studies have been carried out to test the surface anesthetic potency of EMLA with the various available topical anesthetic agents on the oral mucosa, however, the results obtained were conflicting.[8-12]

Hence, this study aims to evaluate the efficacy of EMLA 5% cream (Eutectic mixture of local anesthetics—lignocaine 2.5% + prilocaine 2.5%) and benzocaine 20% gel in reducing the pain during administration of injectable local anesthesia in children.

MATERIALS AND METHODS

Materials

Two topical anesthetic agents were used in this study: EMLA 5% cream—lignocaine 2.5% + prilocaine 2.5% (EMLA™ Astra Zeneca UK Ltd.) (Fig. 1). Benzocaine 20% gel (Vishalcare Gel, Vishal Dentocare Pvt Ltd, Ahmedabad, Gujarat, India) (Fig. 2).

Methods

This study was conducted on 10 pediatric patients visiting Department of Pedodontics and Preventive Dentistry, Dr DY Patil Dental College and Hospital, Pimpri, Pune.

Inclusion Criteria

1. Children within the age group 6 to 9 years were selected since the cognitive skills necessary for the use of visual analogue scale for pain assessment have not developed in children younger than 6 years of age.[13]
2. Mobile deciduous second molars bilaterally that could be treated under infiltration anesthesia.

Exclusion Criteria

1. History of allergy to any components of local anesthetic agents used during the study.
2. Dental or dentoalveolar abscess.
3. Presence of any underlying systemic disease.
4. Immunocompromised patients.

The posterior areas to be infiltrated on the buccal and lingual aspect were chosen as the test sites. The test areas were dried using a sterile gauze piece following adequate isolation.

In the first appointment, benzocaine 20% gel was applied to the test sites on one side of the jaw with a cotton tip applicator which was completely soaked with the topical anesthetic gel for a period of 5 minutes. In the second appointment, EMLA 5% cream was applied to the test areas on the other side of the jaw with a cotton tip applicator similarly soaked with the topical anesthetic cream for a period of 5 minutes.

Following this, local anesthesia aquacaine plus- 2% xylocaine + 1:100,000 adrenaline (Aqua Fine Injecta Pvt. Ltd, Pune, India) was infiltrated on first appointment on both buccal and lingual test areas which were surface anesthetized. The needle was concealed in an attempt not to create a fear promoting situation that could alter the subject's pain perception. Every effort was made to avoid the use of fear promoting words or display fear promoting situation.

During the injection procedure, the response of the child was observed. Each child quantified the pain perception during the injection using a Wong-Baker faces pain rating scale[14] (Fig. 3).

Fig. 1: EMLA 5% cream (EMLA™, Astra Zeneca, UK Ltd.)

Fig. 2: Benzocaine 20% gel (Vishalcare Gel, Vishal Dentocare Pvt. Ltd, Ahmedabad, Gujarat, India)

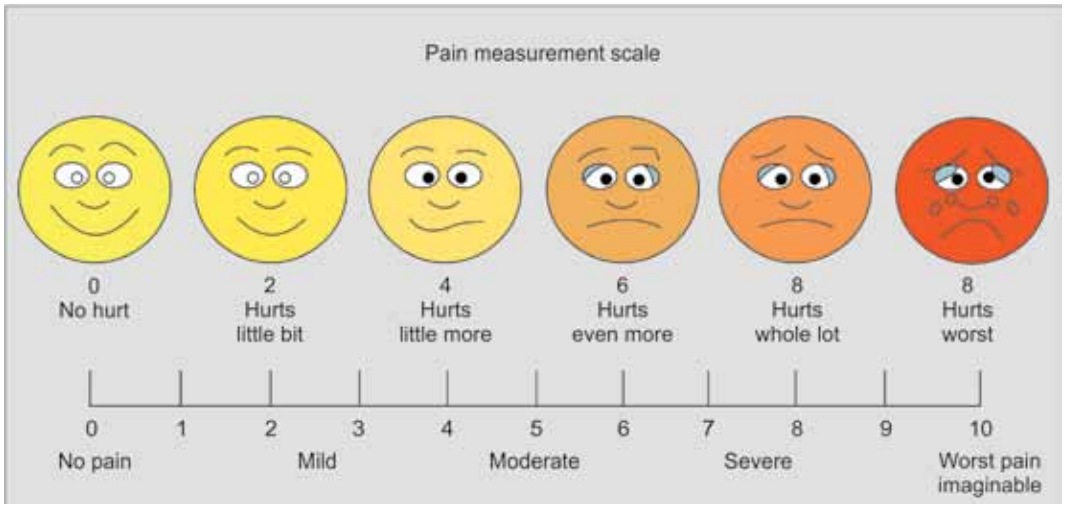

Fig. 3: Wong-Baker faces pain rating scale

The child was asked to choose the face that best described the amount of pain he/she had at that particular moment.

No instructions were given to the child regarding the procedure or the use of Wong-Baker faces pain rating scale by the operator or the parents prior to the study. The pain score for both buccal and lingual test areas on both the sides were recorded and the average pain score of both buccal and lingual sites for both the test agents was considered for statistical analysis.

All the data obtained were subjected to statistical analysis using SPSS v.16 software. The data was thus analyzed and tested using Mann-Whitney U-test.

RESULTS

The mean pain score observed during the administration of local anesthetic injection after the application of EMLA cream was 1.1 ± 0.88, while that with benzocaine gel was 3.22 ± 0.92. This difference was statistically significant ($p < 0.001$) (Table 2).

Figure 4 depicts EMLA cream to be three times highly effective than benzocaine gel in reducing the pain experienced during the administration of local anesthetic injection.

Table 1: Mean pain score values with EMLA 5% cream and benzocaine 20% gel

Patient	*Mean pain score with EMLA*	*Mean pain score with benzocaine*
1	1	3
2	1	3
3	0	2
4	1	2
5	3	5
6	0	3
7	1	4
8	2	4
9	1	3
10	1	3

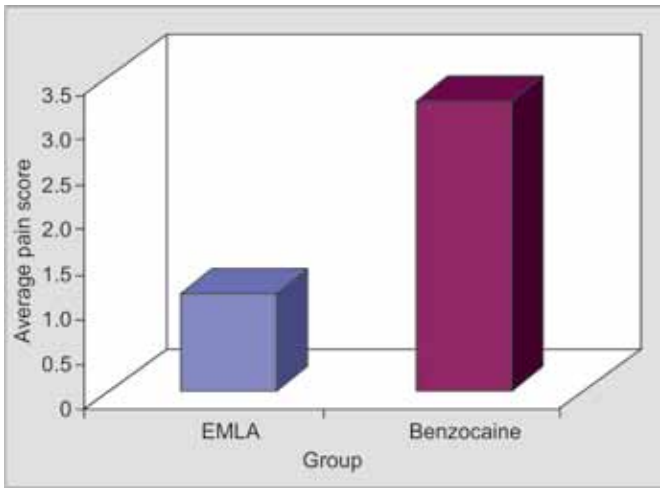

Fig. 4: Comparison of pain score in EMLA and benzocaine group

DISCUSSION

Various topical anesthetic agents have been used on the oral mucosa with reported varying degrees of surface anesthetic properties. This property of topical anesthetics has led to decrease in the level of pain experienced by the patients, thus resulting in greater acceptance of dental procedures. EMLA, which is one of the topical anesthetic used, is an eutectic mixture of 2.5% lignocaine and 2.5% prilocaine along with Arlatone as emulsifier and carbopol as a thickener.[6] The first study investigating the application of EMLA cream in the oral cavity was performed by Holst and Evers[7] in Sweden by comparing its pain reduction effect during a needle insertion to a placebo and it was found that EMLA was very effective in reducing pain experience. Since then a number of studies have been conducted to investigate its efficacy for reducing the pain during injection. Vickers et al[8] evaluated the efficacy of 5% EMLA cream, 5% xylocaine and NUM (lignocaine 5%, amethocaine 1.7%) and found EMLA to be the most effective topical anesthetic agent in reducing the

Table 2: Comparison of mean pain score values with EMLA 5% and benzocaine 20% using Mann-Whitney U-test

Parameters	*EMLA (mean ± SD) (n = 10)*	*Benzocaine (mean ± SD) (n = 10)*	*MW-test (Z-value)*	**p-value*
Pain score	1.1 ± 0.88	3.22 ± 0.92	3.46	< 0.001

*p-value significance tested: Mann-Whitney U-test

pain experienced during needle insertion. Roghani et al[9] evaluated the efficacy of 5% EMLA cream, 10% benzocaine and 10% lidocaine, and found EMLA 5% cream significantly reduced the pain threshold and was superior in performance to all other topical anesthetics. Al-Mehl and Andersson[10] also found EMLA 5% cream/gel to be superior than 20% benzocaine gel in terms of pain reduction during palatal anesthetic infiltration.

In the present study, efficacy of EMLA 5% cream was compared to that of commonly used benzocaine 20% gel and it was found that EMLA 5% cream was 3 times superior to benzocaine 20% gel with regards to pain reduction. The superior surface anesthetic property of EMLA could be attributed to its high pH (pH 9.6). This is in accordance with Setnikar[15] who stated that increasing the pH increases the potency of the topical anesthetic agent. This could also be attributed to the combination of melting points of the two drugs: lignocaine (66°-69°C) and prilocaine (36°-38°C). When these agents are combined together in eutectic form, the melting point of the mixture is lowered to 17°C. This new physical property allows the anesthetic agents to form liquid at mouth temperature and thus facilitates rapid absorption of the bases from the site, thus facilitating rapid onset of action.[16]

However, it was observed that EMLA had a low viscosity due to which localization of this topical anesthetic to the desired site on the oral mucosa was difficult. To overcome this difficulty, Svensson and Peterson[17] advocated the use of orahesive bandages in an attempt to localize this drug. However, Tulga and Mutlu[18] have reported difficulty in sticking these bandages onto the oral mucosa. On the contrary, benzocaine which has also been reported to possess excellent surface anesthetic properties, has low water solubility and its ability to remain localized at the site of application, provides a prolonged duration of action.[19] However, its surface anesthetic potential would also vary depending upon the manufactured brand used to obtain the desired effect, which could also be attributed to its lower potency in our study. Another shortcoming of this study could be attributed to the small sample size used, the results of which cannot be used to generalize the surface anesthetic potential of EMLA or benzocaine. Hence a larger sample size would be required in order to derive a suitable conclusion.

CONCLUSION

Based on the results obtained in the present study, it can be inferred that EMLA 5% cream is comparatively better than Benzocaine 20% gel with regards to pain reduction during the administration of local anesthetic injection in children. Since, the numbers of studies on this subject are sparse and the clinical results are mixed, the results obtained can be explained on the pharmacological basis of the individual topical anesthetic agent. However, a further research in this field would help determining the efficacious topical anesthetic leading to satisfy the objectives of operative dentistry especially in pediatric patients.

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