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Recent Advances in Topical Anesthetics Used in Pediatric Dentistry: An Update

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Abstract

Anesthesia is widely used in many medical and dental procedures. Their distribution and efficiency depend on many factors and can be improved by using free bases, increasing the amount of chemicals, and lowering the melting point. Many types of local anaesthetics are available. The drug should be carefully monitored for use, area and time of use, patient's age, weight and side effects. The pain and anxiety are the key factors for the positive outcome of the treatment in pediatric dentistry. Topical anesthetics are crucial for pain and fear associated with treatments.

Keywords: Topical dental anesthetic, Eutectic mixture of local anesthetics, Pain, Recent trends, Topical pediatric dentistry.

Introduction

Pain: The International Association for the Study of Pain defines pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage".[1]

Topical anesthesia

Topical anesthesia is defined as superficial loss of sensation in conjunctiva, mucous membranes, or skin, produced by direct application of local anesthetic solutions, ointments, gels or sprays. Trypanophobia is the fear of needles. Because anesthetics stimulate peripheral nerves to reduce pain sensation prior to local anesthetic injection, they show promise in reducing pain and anxiety, ultimately increasing interest from dentists. The current literature review aimed to bring together various studies on pain and local anesthesia treatment in children. Anesthetic, also known as anesthesia, can be used within just a few millimeters (2x3 mm) of the mucosal surface. The effectiveness of anesthesia depends on factors such as composition (simple or combined), sensitivity and exposure (type and time). Concentration: Lidocaine (2 ± 10%), benzocaine (10%) reported for use in children.2 Ingredients: Lidocaine and benzocaine are the most common anesthetics and can be used alone or together to create a combination preparation. Eutechtic local anesthetic is a 1:1 weight emulsion of lidocaine (2.5%) and prilocaine (2.5%).EMLA has a lower melting point, so the local anesthetic is in liquid form. It is available in cream and disc form. While it was previously used only as a local anesthetic on the skin, it is now also used in the mouth. It is a combination containing Sitakaine - Benzocaine (14%) + Butyl Aminobenzoate (2%) + Tetracaine + Benzalkonium Chloride (2%). It comes in spray and liquid form. Procaine - combination of 8% lidocaine + 0.8% dibucaine. TAC (tetracaine + epinephrine + cocaine) and XAP (xylenephenylephrine) are several local anesthetic preparations. Generally speaking, planning together is better than planning alone. Exposure (type and duration): The method of administration (liquid, gel, spray, patch and cream) and duration of anesthesia may affect the effectiveness of anesthesia, but there is insufficient evidence. The duration of anesthesia is not directly related to the improvement in treatment.

1. **Skin Penetration Routes** There are three ways to pass through the stratum corneum, which pose major obstacles to the administration of anesthesia. Intercellular pathway (through the intercellular space of cornified keratinocytes), intracellular or intercellular pathway (through keratinocytes), and transappendix pathway or shunt (through the opening of hair follicles and sweat glands). Since there is no stratum corneum, areas such as the mouth, genitals and conjunctiva are easier to penetrate than the horny areas.[3]
2. **Factors Determining The Dermal Drug DeliveryDrug form**

While the free base is lipophilic and can penetrate the stratum corneum alone, the salt form requires specific delivery to penetrate.

Melting point and eutectic mixtures

The lower the melting point, the better the permeability. The eutectic mixture has a lower melting point and therefore has better permeability than either element on its own.

Concentration of drug in vehicle

The higher the concentration of the drug in the carrier, the higher the permeability.

Skin permeation enhancers

These compounds occasionally increase the permeability of the skin and reverse the increased permeability of the stratum corneum. These may include:

- Water, alcohol, glycerin, low molecular weight ethers, sucrose esters, silicone oil, etc. solvents such as,
- Surfactants such as ionic, non-ionic, bile salts.

- Various medications such as urea, anticholinergic drugs. The tested were eucalyptus oil and soybean casein.

Physical means of enhancing permeation

Skin penetration of local anesthetics can be improved by the following physiological measures:

1. Skin exfoliation.
2. Alcohol degreasing.
3. Cover the application area with a dressing or a patch of microporous and non-porous material such as tegaderm.
4. Iontophoresis (lowvoltage electric current that pushes the medicine through the skin).

Lidocaine HCl 10% / Epinephrine 0.1% Topical Iontophoretic Patch (LidoSite) is the first prefilled active anesthetic patch approved by the US Food and Drug Administration (FDA). The disadvantages of iontophoresis technology are:

- When used more frequently or for a longer period of time, it may cause skin irritation.
- Longterm use may also cause electrochemical polarization of the skin, thus reducing the intensity of the current flowing through the skin,
- A slight electrical sensation may be bothersome for some patients.
- Expensive and large equipment and
- It cannot be used on large areas of the bod

5. Electroporation (using short, highvoltage electrical pulses to create pores in the skin). Electric pulses are used for less than a second; Therefore, skin polarization has nothing to do with electric currentor chemical diffusion. Ultrasonic induction or sonication (low frequency, ultrasonic energy affects the stratum corneum) - Ultrasound improves drug delivery by cavitation, microvaporization, and heating. The frequency that may be used can be high frequency in the range of 0.7-16 MHz or low frequency in the range of 20to 100 kHz. Low frequency ultrasonic delivery may allow transdermal delivery of hydrophilic and high molecular size osmolytes at therapeutic levels.
6. Magnetophoresis/magnetokinesis (using a magnetic field to improve penetration).
7. Thermal properties (heats and increases skin permeability).
8. Erbium:YAG laser pretreatment.[4]
9. Skin care before using the manual plastic micro needle array.

3. **Various Topical Preparations**

Eutectic mixture of local anestheticsA eutectic compound is a compound that melts at a lower temperature than one of its components, allowing more anesthetic to be used. It is a beverage with a melting point of 18°C, containing 5% oil in water, 25 mg/mL lidocaine, 25 mg/mL prilocaine, thickener, emulsifier and distilled water adjusted to pH-9.4. EMLA is used in a thick layer (1-2 g/10 cm2, maximum dose 20 g/200 cm2) on damaged skin. The depth of anesthesia depends on the time of contact with EMLA. It was determined that the anesthetic effect reached a depth of 3 mm after 60 minutes of application and 5 mm after 120 minutes of application. Skin analgesia should improve for up to 3 hours with occlusive dressing 1-2 hours after cream removal. EMLA should not be used on hands and feet due to differences in penetration. EMLA is a Pregnancy Category B drug, but it should be used with caution in breastfeeding mothers because lidocaine passes into breast milk.[3]

Tetracaine, adrenaline (epinephrine), and cocaine (TAC)

It contains 0.5% tetracaine, 0.05% epinephrine and 11.8% cocaine. This is the first local anesthesia

combination found to be effective for nonmucosal cutaneous lacerations of the face and scalp. Apply 1 ml/cm2 to the wound using a cotton applicator and leave for 20 to 40 minutes. However, it is no longer used due to toxicity and cost concerns, as well as government regulations to control cocaine related problems.

Lidocaine, epinephrine, and tetracaine (LET)

A safer and more effective alternative to TAC contains 4% lidocaine, 0.1% epinephrine, and 0.5% tetracaine. LET is used to treat nonmucosal skin tears by applying a few drops directly to the wound. Then use 1to3mL of gel or medicine directly on the wound with cotton swab and apply strong force for 15to30 minutes.It can be used safely in children over 2 years of age. LET is less useful in terminal diseases. Since LET contains epinephrine, application to small veins of the body, such as the fingers, should be avoided. Caution should also be exercised when considering the use of LET on sterile wounds, complex wounds, or wounds larger than 6 cm. LET and TAC do not work on weak skin.

Bupivanor

Contains 0.48% bupivacaine and 1:26000 norepinephrine. Bupivanor is a good alternative to TAC and lidocaine infiltration for local anesthesia, especially during the treatment of lacerations on the face and scalp.[5]

ELA-max 5

Itis marketed for the temporary treatment of anorectal pain. ELAmax is applied to the skin with or without competition for 15to40 minutes, providing a longer anesthesia period than nonliposomal drugs. The maximum size of the application is 600 cm2. In children weighing over 20 kg, one application of ELAmax cream should not exceed 100 cm2. and phenylephrine.[6,11]

Betacaine-LA

LA is a general anesthetic and its exact ingredients are a trade secret. The pocket insert for this product states that lidocaine and prilocaine are 4 times more effective than EMLA and therefore should not be used in areas larger than 300 cm2 for adults and is not recommended for children. [7,8]

4% Tetracaine (amethocaine)

It is a longlasting ester anesthetic based on lecithin gel, r ecommended to be used for 30 minutes with an occlusiv e dressing, at a maximum dose of 50 mg.

Trocaine

It is 4% lidocaine in gel microemulsion dispersion. The manufacturer's recommended application time is 30to60 minutes. The maximum usable space is 600 cm2 for adults and 100 cm2 for children.

S-Caine Patch™ and local anesthetic peel

A patch (manufactured by ZARS, Inc., Salt Lake City, UT, US 1:1 eutectic mixture of 70 mg lidocaine and 70 mg tetracaine base with oxygen activated heat is used to assist in induction of body changes and local anesthesia. The heating element maintains the temperature (39°C-41°C) for more than 2 hours.[9,10]

Lidoderm Patch

Lidoderm is a patch containing 5% lidocaine. Each patch contains 700 mg lidocaine (50 mg/g adhesive) in a water base. It was recently approved by the FDA for the treatment of pain resulting from post-herpetic neuralgia.[11]

Proparacaine or proxymetacaine

Itis suitable for use in eye medication at a rate of approximately 0.5%. With a single drop, anesthesia usually begins to act within 30 seconds, maximum anesthesia is achieved in 5 minutes, and the duration of eye anesthesia is 15to25 minutes.

Miscellaneous agents with topical anesthetic potential

8 to10% Capsaicin (acts on vanillic acid transient receptor potential 1, a transcription factor of the vanillic acid receptor family subtype 1), tetrodotoxin, 0.8% nalbuphine, ethyl chloride spray etc[12]

4. **Clinical applications**

A. For topical creams on sensitive skin EMLA, Tetracai ne 4%, S-Caine Patch™.

B. Reduce discomfort before injections or taking intrav enous and intravenousEMLA, tetracaine 4%.

C. C. For chronic pain symptoms, topical lidocaine/tetracaine can be use to treat myofascial trigger points. It effectively treats trigeminal neuralgia.

D. It relieves itching and pain caused by minor burns, blisters (such as cold sores, sunburns, insect bites), stings, poison ivy, and minor cuts and scrapes.), Bupivanor, ELA - Max.

E. To assist with local application of sleep fiberopticcannulation, use “on-the-go injection” technology, such as the MADgic device, 2% or 4% lidocaine.

F. In ophthalmology and optometry - 0.5% proparacaine, 0.4% oxybuvacaine, 2% lidocaine hydrogels and drops, 0.5% tetracaine.

G. In dentistry, to numb oral tissues and reduce symptoms of aphthous stomatitis before using local anesthetic - 2-8% lidocaine, 10% and 20% benzocaine, EMLA.

H. For otolaryngology, day care and in office procedures

I. Tympanic anesthesia for tympanocentesismyringotomy; insertion, removal or manipulation of the compensation tube.

J. Nasal indications include evaluation using tight or flexible endoscopy, nasal debridement, treatment of epistaxis, treatment of nasal fractures, treatment of abscesses and hematomas. It is often combined with vasoconstrictive medications (e.g. 0.05% oxymetazoline) to reduce mucosal oedema.

K. The topical anesthetics applied to the mucous membranes in the oral cavity can be useful in alleviating the pain associated with infiltration of local anesthetics, which can be a source of great apprehension for many patients.

L. Aiding intubation or laryngoscopy with fibreoptic bronchoscopy in the oral cavity and oropharynx, local examination, closure of lacerations, incisions, and fluid peritonsillar abscesses, and treatment of patients with major alveolar injuries such as upper jaw and lower jaw fractures have been repaired. Anesthesia used for the oral mucosa effectively reduces the pain associated with local anesthesia, which can be a major concern for many patients. Laryngeal anesthesia facilitates laryngoscopy and bronchoscopy, nasoesophagealgastroduodenoscopy, and endotracheal tube placement when elective or emergency intubation is required.

M. For use in superficial dermatological, cosmetic, and laser procedures such as venipuncture, hair and wart removal, harvesting of split skin grafts, shaving or excisional biopsies, dermabrasion for tattoo removal, debridement of venous leg ulcers, scarification surgery, and electrosurgery to remove red spots and more. wine to treat excess, - EMLA 5%.

Table 1: Various studies in children

Sn.	Author-year	Intervention	Site/ process	Pain perception/ reaction measure	Results
1.	Hameed et al. 2018. (Hameed, Sargod et al. 2018)	Children age group of 8–10 years Tetrafluorethanecryoanesthetic spray (10–15 seconds) compared to lignocaine spray	IANB with 26-gauge needle.	VAS SEM	Pain scores were lower in the tetra fluoroethane group compared to t opical lidocaine
2.	Lathwal et al. 2015	Children age 5–8 years. One minute ice cone vs5 seconds refrigerant spray vs benzocaine.	IANB and Greater palatine block with 25 gauge needle.	SEM VES	Ice cone had shown significantly higher efficacy as compared to benzocaine and refrigerant.
3.	Ghaderi et al. 2013	Children age 8–10 years buccal infiltration (20% Benzocaine) on one side (control) for 1 min and topical anesthetic agent plus one minute of ice pack on the other side.	buccal infiltration With 27 gauge needle.	SEM VAS	Cooling the injection site before infiltration of local anesthetics in the buccal mucosa for 1min, reduced pain perceived by pediatric patients.
4.	Aminabadi et al., 2009	Children aged 5–6 years of age Benzocaine for 1 min followed by a 2-min. Application of ice before injection of local anesthetics.	IANB with 27 gauge needle.	SEM	Precooling of the soft tissues of an injection site prior to the administration of a local anesthetic can minimize the discomfort and anxiety associated with the injection procedure.
5.	Dassaraju and Nirmala 2020	Children aged 7–11 years. Cetacaine, EMLA, 20% Benzoczinecompared.	Palate Needle pricks 27 gauges.	CPS FLACC	Cetacaine was best among all.
6.	Gupte 2019	Children aged 6–12 years.2%lignocaine gel and 10% lignocaine spray.	Palate Needle prick 27 Gauge	VAS	10% Lignocaine spray was better.
7.	Deepika 2012	Children aged 6–12 years Compared	Palatal needle prick. 27 gauge	VAS SEM	No significant difference between both.

		procaine (8% lignocaine + 0.8% Dibucaine) with 20% benzocaine.			
8.	Kreider 2001	Children aged 6–15 years 20% benzocaine vs 20% lignocaine.	Palatal needle prick. 27 gauge	SEM WPB-FPS	20% Lignocaine in patch form was more efficient than 20% benzocaine gel.
9.	Primosch 2001	Children aged 6–15 years 20% benzocaine and 5% EMLA	Palatal needle prick. 27 gauge.	CPS FLACC	No significant difference between both.

Source- Different studies with comparison of different topical anesthetics done on children adapted byTirupathi S et al.

Conclusion

Pain management is important for all pediatric dentists. Anesthesia is very important for good pain management in children. It is important to understand the correct choice of anesthesia for the treatment of dental problems in children. Since various agents and products have been used for some time, the time is not far when we will completely eliminate the use of infiltrative local anesthesia. However, users need to understand the pharmacology and side effects of the drug used.

References

1. Treede RD. The international association for the study of pain definition of pain: as valid in 2018 as in 1979, but in need of regularly updated footnotes. Pain Rep 2018;3(6):643–645. DOI: 10.1152/ ajplegacy.1975.229.6.1510.
2. Tirupathi S, Rajasekhar S. Topical Anesthesia in Pediatric Dentistry: An Update, International Journal of Clinical Pediatric Dentistry, 2022;15(2)240-244. DOI-10.5005/jp-journals-10005-235.
3. Kumar M, Chawla R, Goyal M. Topical anesthesia. J AnaesthesiolClinPharmacol 2015;31:450-6. DOI:10.4103/0970-9185.169049.
4. Baron ED, Harris L, Redpath WS, Shapiro H, Hetzel F, Morley G, *et al.* Laser-assisted penetration of topical anesthetic in adults. Arch Dermatol 2003;139:1288-90.
5. Smith GA, Strausbaugh SD, Harbeck-Weber C, Shields BJ, Powers JD, Hackenberg D. Comparison of topical anesthetics without cocaine to tetracaine-adrenaline-cocaine and lidocaine infiltration during Kumar, et al.: Topical anesthesia repair of lacerations: Bupivacaine-norepinephrine is an effective new topical anesthetic agent. Pediatrics 1996;97:301
6. Daneshkazemi A, Abrisham SM, Daneshkazemi P, Davoudi A. The efficacy of eutectic mixture of local anesthetics as a topical anesthetic agent used for dental procedures: A brief review. Anesth Essays Res. 2016;10(3):383-387.
7. Hassanein PH, Khalil A, Talaat DM. Pain assessment during mandibular nerve block injection with the aid of dental vibe tool in pediatric dental patients: a randomized clinical trial. Quintessence Int 2020;51(4):310–317. DOI: 10.3290/j.qi.a44145.
8. Bilsin E, Gungormus Z, Gungormus M. The erfficacy of external cooling and vibration on decreasing the pain of local anesthesia injections during dental treatment in children: a randomized controlled study. J PerianesthNurs 2020;35(1):44–47. DOI: 10.1016/j. jopan.2019.06.007.
9. Khan BS, Setty JV, Srinivasan I, *et al.* Low level Laser Therapy to Alleviate Pain of Local Anesthesia

Injection in Children: A Randomized Control Trial. Int J ClinPediatr Dent 2023;16(S-3):S283–S287.

10. Ferrazzano, G.F.; Di Fabio, G.; Gatto, R.; Caruso, S.; Botticelli, G.; Caruso, S. Effectiveness and Tolerability of a New Formulation of a Topical Anesthetic in Reduction of Pain and Parents' Satisfaction in Pediatric Dentistry. Children **2023**, 10, 444. https:// doi.org/10.3390/children10030444.
11. Garret-Bernardin A, Cantile T, D'Anto V, et al. Pain experience and behavior management in pediatric dentistry: a comparison between traditional local anesthesia and the wand computerized delivery system. Pain Res Manag 2017;2017:7941238. DOI: 10.1155/2017/7941238.
12. Alvarez G.G, Romero C.C, Gonzalez G.I.M, Hernanadez G.R.C, Morteo L.T, Reyes L.P.F, Lamas N.R.C, Soto J.M.S, Topical anesthetics in pediatric dentistry: A literature review, 2022; 8(3): 283-286