

Local Anesthetics in Pediatric Dentistry

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Abstract

Children should feel comfortable at the time they visit the dentist. Local anesthesia plays an important role in controlling the pain and discomfort during dental treatment. Anesthetizing the children's teeth is safe with low risk when an expert pediatric dentist uses local anesthetic with the proper techniques. Besides, the child will remain alert at the time of use.

The local anesthetic is the most commonly used drug in dentistry. Lidocaine is the most commonly used drug used for local anesthesia. This anesthetic can disturb the nerve signals. In this way, the anesthetic will prevent the production and transmission of the nerve signals. When using an anesthetic drug in children's dentistry, the dose of the drug which is used should be reduced and modified.

It should be clarified that dentists who use an anesthetic for children should be adequately trained and prepared to manage potentially serious reactions to anesthetics. Common side effects in children can be chewing lips (very common), numbness, and tingling.

Keywords: *Local Anesthesia; Controlling Pain and Discomfort; Lidocaine; Nerve Signals; Common Side Effects; Pediatric Dentist*

Introduction

Everyone believes that pain control is one of the most important aspects of guiding the child's behavior in dentistry. If children experience pain during simple restoration or surgery, their future condition as a dental patient may be damaged. So, reducing discomfort to the minimum possible and controlling painful situations is important at each appointment which can lead to a success of the clinical process in pediatric dentistry [1-3]. There are many pharmaceutical strategies for controlling the pain that helps children to face up to these conditions, both before and after dental work.

Most of these strategies include the use of anesthetic and analgesic drugs. When restorative work is required on permanent teeth, a local anesthetic is prescribed which injection of anesthetic even though is accompanied by some discomfort. The same is true for the preparation of a cavity in the primary teeth. If the child is comfortable and painless during pediatric dentistry, this can be done more effectively. Application of local anesthesia prevents the discomfort caused by tooth preparation and removing the tooth decay. Naturally, there is no contraindication to using anesthesia in the youngest child treated in a dental office.

There are two types of local anesthesia which are esters and amides [4]. The type of localized anesthetic for a child depends on the status of each person, and the amount and complexity of the dental work. The most common type of local anesthetics in pediatric dentistry is amides [4].

The mechanism of action of the local anesthesia prevents the production and transmission of the nerve signals. Anesthetic drugs disrupt the function of the sodium channel; consequently, there is no possibility of transferring other nerve signals [5].

Even though the side effects of local anesthesia are rare but a few important ones are high heart rate [6], lips biting [7,8], numbness, tingling, and some minor pain around the injection site.

Local anesthesia

Children should have a comfortable and painless experience when they visit a dentist. Local dental anesthesia is an important tool for controlling pain and discomfort during dental treatments. In the case of local anesthetic, the child's consciousness and vigilance are maintained; therefore, it is a safe way to treat children's teeth. Children's dental anesthesia prevents the production and transferring of nerve signals [5]. However, when children get relaxed, the local anesthetic doses should be reduced. Dentists using anesthetics for children, should have more training, and be prepared for serious child reactions. Lidocaine is a local anesthetic that is most commonly used in pediatric dentistry [9,10].

Mechanism of action

An anesthetic drug blocks the signal transmission pathway between the pain source, or the stimulant and the brain. The task of the nerve is to transmit messages from one organ to another. These messages are in the form of electrical signals, which are referred to as action potentials. Anesthetic drugs disrupt the function of a particular gate called the sodium channel [5,11].

When the sodium channel of the nerve is blocked, there is no possibility of transferring other nerve signals. The only place where local anesthetic molecules have access to the nerve shell is in the area of the nodes of Ranvier where abundant sodium channels have been observed [12-14].

Local anesthetic groups

Local anesthetics used to anesthetize tooth are classified into two groups:

- Amides (Lidocaine, Articaine, Bupivacaine, Prilocaine, Mepivacaine) [15-17].
- Esters (Benzocaine, Procaine) [15-17].

These names are derived from the type of chemical relationship between the molecules of these drugs. The majority of these anesthetic drugs, such as lidocaine, are taken from triamines [18,19]. Moreover, all anesthetics drugs are amphipathic [14,19,20]. This means that these drugs have both lipophilic and hydrophilic properties, which are usually in the opposite direction. The lipophilic end of the molecule absorbs the lipids while the hydrophilic end of the molecule absorbs water [19]. These drugs are also used as anesthetics in children, of course, at lower doses.

Preparation of a child for injection

Watching a child undergoing dental treatment with localized anesthesia may be a very unpleasant experience for most parents. Children can feel parental concerns, so if parents want their presence to be useful for their child, they must try to be calm enough and encouraging. There are ways in which they can help their child, even if they feel uncomfortable being in that situation (watching the injection):

- Children can hold a toy in their hands during performing the anesthetic injection.

- Parents can cuddle the child's hand or even their hair so that their children know; they are always on their side. Keeping a child's hand or touching his hair and face, reminds the presence of his mother.
- Parents can whisper and talk to their child, or even sing for him while the dentist injecting the local anesthesia. Hearing the mother's voice gives the child strong confidence.

Advantages of local anesthetics for children

Injection of local anesthetics is the simplest form of anesthesia in dental treatments. When used properly, they are safe. Comparing to other types of anesthetics, local anesthesia has several advantages. It does not have the disadvantages of some of the risks and unpleasantness associated with oral sedation and general anesthesia. The good point is that the child can back to his normal activities as soon as the dental treatment is over without having any unpleasant sensations such as nausea and vomiting, which has always been seen after the application of general anesthesia [21]. Local anesthetics are safer than general or systemic anesthetics [22]; therefore, they are used whenever possible. Also, they are relatively easy to administer and readily available. Furthermore, when used with topical anesthesia, it makes the injection painless for the children.

The following are some important advantages of using local anesthetics in children [23]:

- Anxiety reduction.
- Dangerous behaviors are prevented.
- Makes the dental procedure easier and faster for the dentist.
- Child's self-harm is prevented during the dental procedures.
- Preventing dental complications.

Vasoconstrictor (which contracts the blood vessels) is usually added to the local anesthetic to increase the duration of anesthesia [24-26]. Vasoconstrictors such as Epinephrine slow down the process of losing anesthesia from the adjacent nerve [26].

Why do some patients do not feel anesthetized after the injection?

In general, the failure of good anesthesia must have different causes. Usually, among the causes which are discussed in the literature, the anatomical differences in individuals, and the difference in positioning of the jaws are the most common causes of this problem in dentistry, but other reasons have been observed in some patients.

Anatomical differences [27-30]

The position of the nerve is different in each person's jaw. Some people the bigger jaw than some others. That's why finding a nerve is difficult. Some people have extra muscle and/or fat around their jaw. In others, posterior teeth loss will make the nerve and foramina location harder. At the same time, poor anesthesia at a young age is much more common due to their various anatomies, depending on the growth stage. In these people, it is much more difficult to inject the local anesthetic into the right place.

Technical errors by the dentist [27-30]

Sometimes the dentist will miss the anatomical site of the nerve, and slide the needle in the wrong place. As a result, if the needle is misplaced a little farther, lower, or above the nerve, the patient's anesthesia decreases. Somewhen, he may not insert the needle at the right depth and accidentally, injects it into the blood vessel.

Inflammation or infection [27-30]

Sometimes lack of a good anesthetized area is due to dental inflammation or dental infection. One theory believes that acidic tissue in the inflamed place reduces the effectiveness of the local anesthetic. In another theory, it is said that due to the use of analgesics to overcome the pain, his tolerance to anesthesia has decreased.

Lack of anesthesia due to the use of defective anesthetic [27-30]

This is a rare situation. Unfortunately, the dentist may seldom use a substance that has been expired; not properly have been preserved; or not have been well produced in the factory. Such a case can be completely solved by using famous brands of anesthetic.

Anxious and uncooperative patients [27-30]

Some anxious patients mistakenly think that they are not anesthetized, and with the start of turbine sounds, they begin to scream. In this case, the dentist by touching the opposing side can show them the difference between an anesthetized and an unanesthetized area, and usually, everything ends there.

Having overly flexible joints [31-33]

Typically, these include a group of people with genetic connective tissue disorders. Patients with Ehlers-Danlos syndrome are one of these groups who is resistant to local anesthetic drugs.

Having red hair [34-36]

Some research suggests that red-haired people (especially females) are more resistant to local anesthetic drugs under the skin. Do not forget, it is pointed to natural red hair.

The ulcer of chewing lips and cheeks in children after dentistry

One common complication after pediatric dentistry is the inadvertent or deliberate chewing of the soft tissue of the lips or inner cheeks by the child. This complication occurs due to the anesthetizing of the soft tissue of these areas that occurs at the same time the teeth are anesthetized. This problem occurs most after local anesthesia injections to treat young children's mandibular teeth, but after maxillofacial anesthesia, it is expected too.

The incidence of this phenomenon is higher in children under four years of age. Soft tissue chewing begins a few minutes right after local anesthetic injection by the dentist when the kid is still sitting in the office room until her teeth are anesthetized. Occasionally, this occurs after the end of dental treatment at home, before the effect of local anesthesia ends.

In these cases, parents often call the office several hours later and wonder or agitated about the appearance of a white wound on the inside of the lips or cheeks: or even they sometimes complain about one-sided swelling of the kids' lips after the dental work.

Prevention: The important points that parents need to know about preventing and treating this condition. Here are some simple recommendations so that may prevent this painful condition, very easily [37]:

- The dentist should select a local anesthetic with a short duration of action which is appropriate for the length of the dental work.

- The warning should be emphasized to the parents. After completion of the dental work, by placing a cotton roll in the mucobuccal fold, the chewing can be prevented.
- Parents should be very careful after the anesthetic injections to their kids, both inside the office before starting work and up to hours after completing their work and returning home; it is essential reminding them to not bite on their lips.
- The child should not eat anything until the effect of the anesthesia has dissipated (usually about two hours after the end of the work).
- The wound caused by the chewing is not related to the contamination of the dental instruments.
- If the child has wounds or swelling of the lips and cheeks, it is best to bring the kid to the dentist. A dentist may prescribe an antibiotic course to prevent secondary infection.
- At home, the wound area should be kept clean with warm saltwater.
- To prevent further inflammation, it would be advisable to place a few ice packs in the freezer for the first 24 hours, and alternately put them on the cheek or lips several times a day.
- Complete recovery of the wound and swelling caused by the chewing of the lips and cheeks takes about a week to ten days. Lubricating the area with petroleum jelly or antibiotic ointment to prevent drying, cracking and pain may be advised.

Other complications and side effects of local anesthetics

Since the 1960s, dentists began to use an anesthetic syringe. With this technique, it can be seen that the needle does not enter the blood vessel in the wrong way before the injection of the anesthetic substance, hence the dentist was able to aspirate before the injection [38]. Regarding the use of anesthetics, a low safety margin exists between the dose of effective medication and the dose of toxicity of the medication. Bupivacaine (Marcaine) is an amyloid anesthetic that can likely react dangerously and should not be used for children. Bupivacaine is 3 to 4 times more potent compare to the other local anesthesia. The local anesthetic effect can last to 24 hours [39].

Lidocaine is less toxic compared to other substances, because its interactions with the sodium channel are “fast entry and fast-exit”, while other anesthetics, such as Bupivacaine, have “fast entry and slow exit”. Overdose of Bupivacaine is difficult to treat because the accumulation of plasma that causes seizures is very close to the state of a heart attack even though there is no evidence to suggest that there is a risk of a heart attack [39].

Like many other drugs, topical anesthetics also have side effects. Although the likelihood of such side effects varies from person to person, it is very necessary to be aware of them. Some of the possible side effects and complications of local anesthesia are included as following [39-43]:

- Temporary problems in eating, drinking, and talking immediately after receiving injections.
- Possibility of dizziness, blurred vision, and temporary loss of control and muscle coordination.
- The possibility of headache or nausea or even vomiting.
- Lose their ability to remember the actual stages of their treatment.

- Possibility of allergic reactions such as acne, tingling (especially lips), and respiratory problems.
- In some rare cases, the possibility of damage to nerves due to accidental needle-sticking.
- The chance of hematoma in the injected area.
- Possibility to produce effects on areas far from the mouth, such as the eyelids (temporary disabling of blinking).
- Possibility of a fast heartbeat because of the presence of vasoconstrictive substances in these drugs.

The effects of local anesthetics on the development and growth of children's teeth

For the first time, a study by researchers at the Peninsula School of Dentistry in China and Switzerland researchers showed that the use of local anesthesia may affect the cellular growth and eruption of the teeth in children [44].

The results of this study were published on September 7, 2015, in the Cell Death Discovery Magazine, the new leading medical research magazine, from Nature publication. This was investigated when children were more likely to undergo dental surgery and local anesthetic due to dental caries or other orthodontic diseases.

Scientists by using pig's tooth and dental pulp cells of young permanent teeth showed that local anesthetic drugs commonly used in dental clinics affected the proliferation of tooth cells. This is the first time that evidence of the effect of local anesthetics on growth, evolution and tooth eruption has been presented. According to researchers, in the treatment of teeth, repeated use of local anesthetics is greater than any other area in the body. Although the maximum anesthetic dose has been specified for different areas, the side effects of the drug on tooth tissues have not yet been thoroughly investigated.

This study showed that the prolonged exposure to high concentrations of topical anesthetics is most harmful since it interferes with the function of mitochondria, which is a "cellular battery," and induces cell death or "Autophagy" [44]. The research team investigated most of the local anesthetic drugs currently used in dental offices in England, Switzerland, and China.

While the effects of local anesthetics on the developing and growing teeth have been determined in this study, the team is keen to do more clinical trials to confirm these results, and to get more complete information before changing the clinical guidelines. They believe parents should not feel their children are at risk; or deprive their children of the treatments they need.

Dr. Bing Hu, head of the study, says that our study for the first time has provided evidence that local anesthetics may affect the development, and growth of children's teeth at cellular and molecular levels. We believe that we need more clinical studies, and we do not wish our findings to be an unnecessary alert for parents, but we expect our research results to correct the clinical guidelines so that we can minimize the dose of local anesthetics in the future.

He further adds that our findings will focus on parents' attention to a healthy diet, promotion of oral health, and regular dental examinations of their children to avoid dental surgeries, such as tooth extraction.

Conclusion

Always some dental procedures have been painful, and to work on teeth, especially primary teeth, the dentists have felt the need to use anesthesia for their comfort and to reduce the anxiety. There are various types of anesthetics in children that one of this anesthesia is likely to be needed if a child needs to have a long or complex treatment during one visit. Also, if a child has special needs; is very afraid of dentistry, or has difficulty sitting steady, using anesthesia can help him calm down.

The use of local anesthetic for teeth in children is usually a very safe method; parents can also help reduce the risk and stress of the child before, during, and after the treatment.

Pediatric dentistry is given extensive training in various ways that can help children relax and ease during treatment. The local anesthetic of children has very low risk, and the goal of pediatric dentistry is to care for children's teeth so that to treat them with very few invasive and safe methods.

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