

Local Anesthesia in Pediatric Dentistry

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Abstract: *Local anesthesia is important in pain control during dental treatment. Perhaps anesthetic injection is the greatest fear source to the patient. Well local anesthesia to be achieved requires agents knowledge being used, best devices and techniques available and the neuroanatomy involved. The dentist should know the complications of local anesthesia to prevent occurrence of these complications.*

Keywords: Local anesthesia, techniques, complications

1. Introduction

Generally, most important aspect of child guidance of behavior in the clinic is the pain control during dental treatment. When children experienced pain during surgical or restorative treatment, their future dental attitude may be damaged as dental patients. For that the important aspect is to decrease discomfort to a minimum and control the situations of the pain at each visit [1]. The most difficult and delicate procedures in pediatric dentistry is local anesthesia. The anesthetic injection shows the most negative response in the pediatric patient. There are many techniques to reduce anxiety and dental fear have been followed for the child patient [2].

The traditional method for local anesthetic injection had been used widely, the researchers continue to develop and investigate more comfortable, alternative methods for producing anesthesia for the dental patient. There was development for a range of devices to deliver anesthesia in the last two decades, without using the standard needle [3].

Local anesthetic failure is not uncommon in dentistry, and it is a feature of dental practice [4]. The highest failure rate record with the inferior alveolar nerve block compared with all other nerve blocks in patients [5].

For all dentists the ability to produce effective and safe local anesthesia is the most important skill required. Perhaps anesthetic injection is the greatest fear source to the patient. Well local anesthesia to be achieved requires agents. knowledge being used, best devices and techniques available and the neuroanatomy involved. Local anesthetic delivery equipment's and agents available produce an array of choices for the practitioner for pain management associated with the dental treatment [6].

2. Definition of local anesthesia

Local anesthesia is the loss of sensation in a well circumscribed space of the body by the conduction process inhibition or excitation depression in the endings of the peripheral nerves [7], without losing of consciousness, so local anesthetic technique differs dramatically in this point from general anesthesia [8].

3. Local Anesthetic Agents

The local anesthetic agents chemically may be divided into two broad groups in common clinical use [9]: **Agents containing an ester linking** (Tetracaine - Procaine - Chloroprocaine - Cocaine - Benzocaine - Cyclomethycaine - Dimethocaine – Propoxycaïne) Metabolized in plasma.

Agents containing an amide ((Dibucaine - Etidocaine - Bupivacaine - Prilocaine - Mepivacaine - Lidocaine - Articaine - Carticaine - Levobupivacaine -Piperocaine– Ropivacain-Trimecaine).

Most amide agents are metabolized in liver, except for Articaine (plasma). For pediatric dentistry the amide type agents are the most common used type of local anesthesia. Lidocaine hydrochloride (HCl) 2% with 1:100,000epinephrine is preferred because of their greater potency at lower concentrations and their low allergenic properties [10].

4. The properties of a local anesthetic

According to [11, 4] the properties of local anesthetic agents are:

- 1) It must not be irritating the tissue during application.
- 2) It must not be causing permanent nerve alteration.
- 3) The systemic toxicity must be low.
- 4) It should be effective regardless whether it is applied locally to the mucous membranes or it is injected into the tissue
- 5) The onset of the anesthetic time must be short.
- 6) The duration of action should be long enough to provide time for the procedure to be completed and not so long as to require an recovery extended time.

5. Composition of Local Anesthetics

According to [12] Composition of local anesthetics are:
Local anesthetic agent: Lignocaine Hydrochloride-2%(20mg/ml).

Reducing agent: it is preservatives for the vasoconstrictor agents.

Vasoconstrictors may oxidize because they are unstable in solution especially when exposed to sunlight for prolonged

time. Sodium metabisulphite is added in the concentration between 0.05% and 0.1% to compete for the available oxygen.

Preservative: modern L.A Stability is maintained by adding caprylhydrocuprienotoxin which includes Methyl paraben (1mg) and xylitol.

Diluting agent: Distilled water.

Fungicide: Thymol.

Vehicle: The isotonic vehicle reduces discomfort during injection .Isotonic solution: Sodium chloride or Ringer's Solution-6mg.

Nitrogen bubble to prevent oxygen in the cartridge from being trapped and potentially damaging the Vasopressor

Vasoconstrictor: adrenaline-1:80,000(0.012mg) To adjust pH-Sodium hydroxide.

According to [11] vasoconstrictor decreasing blood flow to the injection site, local anesthetic absorption by cardiovascular system is solved, decreasing the risk of local toxicity, remaining higher volume of local anaesthetic agent for longer period in and around the nerve for increasing the duration of action, bleeding decrease at the administration site.

6. Anesthetic Action

Many concepts involving the anesthetic agent action on nerves, from these concepts the anesthetic disturbs the impulses traveling down the nerve length itself by preventing the ions influx of the sodium across the membrane of the neuron. The local anesthesia acts on the axonal membranes of peripheral nerves while general anesthesia affect the synapses of the central nervous system. Local anesthesia act through the phase of nerve depolarization that generates impulse. Reducing the depolarization rate and inhibiting the nerve from reaching the potential fire [9].

7. Topical Anesthesia

Topical anesthetics act on the peripheral nerves and reduce the sensation of pain at the site of application. In dentistry, they are used to control local pain caused by needle prick, placement of orthodontic bands, the vomiting reflex, oral mucositis, and rubber-dam clamp placement [13], thus generate positive responses towards dental treatment in patients [14]. Traditional topical anesthetics contain lidocaine or benzocaine as an active ingredients and are used in the form of solutions, creams, gels, and sprays [13].

8. Local Anesthesia Techniques

The Main Techniques:

There are several techniques of local anesthesia [15]:

Infiltration (Supraperiosteal) the deposition of the solution close terminal sections of the nerves.

Nerve block

Intrapulpal supplementary technique it has limited applications as it can only be used if the pulp is exposed.

Intrapulpal anesthesia used for pulpotomy did not interfere with the healing process of pulpotomizedteeth [16].

Supplementary Techniques

For optimal anesthetic achievement in patients with failed primary regional block injections, it has been advised to use the supplemental anesthesia [17], such as inferior alveolar nerve block failure with patients suffering from irreversible acute pulpitis it can either intraligamentary or intraosseous supplementary injections [18,16]. The aim of the supplemental injections is to introduce the anesthetic solution around the root through the cancellous bone [19].

In contrast to the inferior alveolar nerve block and local infiltration techniques, these supplementary techniques prevent the anesthesia of tissues such as lips and tongue hence, decrease the chances of cheek or lip biting (selftrauma). It necessitates minimum or least dosage of local anesthetic and minimizes bleeding during the surgical procedure and the onset time can be considered rapid if not immediate [20].

The disadvantages are the anesthetic solution may leak into the oral cavity during the anesthetic procedure resulting discomfort and an unpleasant or bitter taste and the effective period of the anesthesia for pulpal and softtissues is very limited [20].

When there is acute infection at the administration site ,the use of the intraligamentary and intraosseous injections are contraindicated [21].

Intraosseous injection made by perforation of the buccal cortical plate to create access to the cancellous bone then depositing the solution through the cancellous bone [16].

Intraligamentary injections include anesthetic solution deposition under pressure into the periodontal space. It is not by forcing the solution to the root apex via the periodontal space, but instead diffusing it via perforations into the surrounding cancellous bone in the dental socket [22]. Intraligamentary injections are used for cavity preparation and it causes no complications regarding the hemorrhage and hematoma formation in hemophilic patients. However, intraligamentary anesthesia is not recommended for treating deciduous teeth because it may damage unerupted teeth. The pressure used during intraligamentary injections causes the anesthetic solution to spread into underlying tooth germs [16].

9. Complications of local Anesthesia

Trauma of soft tissue

Self-induced injuries such as cheek and lip biting are known to be possible complications of local anesthesia after dental procedure in children [23]. The parents of the children who get regional block dental anesthesia in the clinic must be told about the soft tissue in the area will be without sensation for 1 hour or more .These children must be noted carefully to prevent biting the tissue inadvertently or purposely [1]. In the recent year, α -antagonist called phentolamine mesylate was introduced to reduce the duration of anesthesia of the soft tissue and the assurance of self-induced injury following a dental treatment [24]. Similarly, injection of submucosal

hyalalazine HCl was showed to be effective and safe for the reduction of the duration of soft tissue anesthesia [25]. Most self-induced injuries after local anesthesia are minor and heal on their own, or may need palliative care such as analgesics or chlorhexidine rinses. Unless the lip becomes infected secondarily no systemic antibiotics are needed. No surgical treatment (e.g., incision and drainage) is needed and complete healing can take up to several weeks [23].

Pain on Injection

When the injection method becomes too tight, rapid solution deposition, a dull needle, or there is a needle with barbs on it can cause pain [4]. Therefore, the speed and pressure control during anesthetic administration could be useful for reducing pain levels. Compassionate and confident dentists can give anesthesia with little to no displeasure [26].

During administration of anesthesia burning sensation may be owing to local anesthetic contamination, pH solution, or over-warmed solution [27].

Computer-controlled anesthetic delivery systems have been introduced to deliver the anesthetic agent at a steady volume and rate regardless of the tissue resistance or density [28].

Neuropathy

Any sensory nerve tissue damage may produce a mixture of paraesthesia (altered sensation which is not painful), anesthesia (numbness), dysesthesias (altered sensation which is unpleasable/painful) and neuropathic pain [29].

Local anesthetic-produced nerve injuries have approximately 80% likelihood of healing. Referral of sensory nerve injuries to the maxillofacial department before 4 months is recommended by many authors [30]. The injury is usually temporary and short term. Have a note in the patient chart if the the patient reports during the injection a shooting sensation that could indicate touching the needle with the nerve [8]. Most cases including neuropathies of lingual nerve (89%) frequently after mandibular nerve blocks [29]. There is no 'fix' for sensory nerve injuries, only protection. Thus we can only wait for healing, when treating the patient by psychological and medical interventions. 81% of the inferior alveolar nerve block injuries heal during 2 weeks [31]. Healing is found to happen about 8 weeks with 85–94% of cases [30].

Hematoma

When incidentally nicking of the blood vessels (artery or vein) during the injection with needle of local anesthesia could results in extravascular spaces effusion of blood with subsequent formation of hematoma [32]. Hematomas mostly occur during inferior alveolar or posterior superior alveolar nerve blocks. During an inferior alveolar nerve block if the hematoma develops, apply pressure over the medial side of the mandibular ramus [33]. After appearance of hematoma digital pressure in the mucobuccal fold far distally can be applied immediately [34]. Explain the complication to patient and report it in the case sheet of the patient and reassure the situation is self-limiting and could be resolved in 7 to 10 days [35]. Immediate ice application is recommended as it works as vasoconstrictor and also as pain reliever. In the first day application of hot pack is

contraindicated or at least for 4 to 6 hours, and could be applied from next day for 20 minutes every hour as it acts as vasodilator with faster blood reabsorption [32].

Infection

Infection is complications that are attributed to solution or insertion of needle [36]. There is danger of transmitting blood borne viruses to patient by the reuse of needle, syringe and local anesthetic agent [37].

Facial Nerve Paralysis

This complication accompanied with an inferior alveolar nerve block [38]. Resulting from inadvertent deposition of anesthetic solution into the tissue of the parotid gland which is located at the posterior border of the mandibular ramus and facial nerve numbness [39]. Before deposition of solution bone must be contacted in the inferior alveolar nerve block to ensure that the needle tip is not in the parotid gland [4]. There is no need for treatment, excepts waiting till the drug action resolves. Assure the patient and explain the condition that is transient, only lasting for few hours, then will resolve without complications. Until muscular movement returns contact lenses must be removed and a patch must be placed above the affected eye till muscle tone gains [40].

Broken Needles

Needle breakage occur because of unexpected sudden movement of the patient. Larger gauge needles (size 27) are less likely to break than smaller ones (size 30) [41]. Habitually, some dentists bend the needle and the metal is weakened in this area [4].

Dislodgement of fractured hypodermic needles can lead to serious and potentially life-threatening consequences by violating adjacent vital anatomical structures [42]. Needle breakage to be prevented during inferior alveolar nerve block, a 27-gauge long needle must be used. In addition, it is important to avoid inserting the needle hub into the soft tissue [43]. In the unfavorable situation when the needle tip not being apparent, the patient must be told, with proper referral to the Maxillofacial department must be made [44].

Anesthetic Toxicity

For pediatric dentists it is most important to be aware about the using of the maximum recommended dosages of the anesthetic solutions because allowable dosages are depend on the patient's weight [1]. Systemic toxicity of local anesthesia take place when a toxic concentration of anesthetic agent in the blood level reaches to cardiovascular system and the central nervous system [45]. Central nervous system signs such as convulsions, excitation, then loss of consciousness and respiratory arrest are initial symptoms, accompanied by cardiovascular signs such as hypertension, tachycardia, and premature ventricular contractions. The patient must be evaluated to prevent systemic toxicity [46].

The local anesthesia volume must be reduced, the treatment of all quadrants at single visit using local anesthetic agent alone must not be done for the lightweight or young patients. Slow and accurate injection method, dosage adjustment, divided administration and aspirating method, using agents with low toxicity such as levobupivacaine, and ropivacaine,

and doing an aspiration test are recommended [47]. At the dental clinic the treatment includes airway saving, 100% oxygen administration, supine setting, and protection from injury in the condition of seizure activity, convulsions treatment (benzodiazepines or thiopental; propanol should not be used in patients with unstable blood pressure, heartbeat) [46].

10. Conclusion

Local anesthesia is the loss of sensation in a well circumscribed space of the body without losing of consciousness, so it is used to prevent pain during dental treatment. Recent techniques had been used in dental anesthesia to reduce pain during dental anesthetic injection. The dentist should know the complications of local anesthesia to prevent occurrence of these complications.

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