LOCAL ANESTHESIA FOR THE CHILD AND ADOLESCENT

One of the most important aspects of child behavior guidance in the dental office is the control of pain during dental procedures. If children experience pain during restorative or surgical procedures, their future as dental patients may be damaged. Therefore it is important at each visit to reduce discomfort to a minimum and to control painful situations.

Local anesthesia is indicated when:

1. Operative work is to be performed on the permanent teeth and in primary teeth.
2. The local anesthetic can prevent discomfort that may be associated with placing a rubber dam clamp, ligating teeth, and cutting tooth structure.
3. Even the youngest child treated in the dental office normally presents no contraindications for the use of a local anesthetic.

TOPICAL ANESTHESIA

It is applied to the oral mucous membranes with a cotton-tipped applicator. It is used to minimize the discomfort associated with the insertion of needle for local anesthesia administration. It has the disadvantage:

1. A disagreeable taste.
2. The additional time required to apply them may increase the child's apprehension concerning the approaching procedure.

Topical anesthetic agent is effective on surface tissues 2-3 mm in depth on oral mucosa. It is present in a variety of forms such as gel, liquid, ointment, patch and aerosol. The agents used as topical anesthesia are:

1. Ethyl p-aminobenzoate (benzocaine): it is present in concentrations up to 20%. It is best suited in dentistry as it provides rapid onset and longer duration of action. It is not known to produce systemic toxicity.
2. Butacaine sulfate
3. Cocaine
4. Dyclonine
5. Lidocaine: it is present as a solution or ointment with a concentration up to 5% and spray up to 10%.
6. Tetracaine

Method of Topical Anesthesia Application

a. The site of application on the mucosa is cleaned and dried with gauze.
b. A small amount of the agent is applied on the tissue by the use of a cotton swab.

c. Topical anesthesia is produced in about 30 seconds (benzocaine), tetracaine is 60 seconds and lidocaine is 3-5 minutes.

LOCAL ANESTHESIA

It can be defined as "the loss of sensation in a circumscribed area of the body due to depression of excitement in the nerve endings or an inhibition of conduction process".

Local anesthetics are "drugs that produce anesthesia in the region where it is applied or introduced".

Requirements of Local Anesthetic

1. It should have potency sufficient to give complete anesthesia.
2. It should be relatively free from producing allergic reactions.
3. It should be stable in solution and readily undergo biotransformation in the body.
4. It should be sterile or capable of being sterilized by heat without deterioration.
5. It should have low degree of local toxicity
    a. It should not be irritating to the tissue to which it is applied.
    b. It should not cause any permanent alteration of nerve structure
6. It should have low degree of systemic toxicity
7. It should possess versatility: it must be effective regardless of whether it is injected into the tissue or applied locally to mucous membranes.
8. It should have a rapid onset and be of sufficient duration to be advantageous.

Classification of Local Anesthetic Agents

1. Ester group:
    a. Benzoic acid esters such as cocaine, benzocaine, butacaine, piperocaine and tetracaine.
    b. Para-aminobenzoic esters such as procaine, propoxycaine and chlorprocaine.
2. Amide group:
    a. Bupivacaine
    b. Lidocaine
    c. Mepivacaine
    d. Prilocaine
    e. Etidocaine
    f. Articaine
3. Quinolone group: such as centbucridine. It is 5 to 8 times as potent as lidocaine with similar onset of action and duration. It doesn't adversely affect the CNS and the CVS in high doses.

Composition of Local Anesthetic Solution

1. Local anesthetic agent: lignocaine hydrochloride 2%

2. Vasoconstrictor: adrenaline 1: 50,000 to 1: 200,000. It is added to:
    a. Delay the absorption of local anesthesia from the site
    b. Provide bloodless field
    c. Prolong the action
    d. Reduce systemic toxicity
3. Reducing agent: to prevent oxidation of the solution such as sodium metabisulfite.
4. Preservative: such as methyl paraben, capryl hydro cuprino toxin
5. Fungicide: Thymol
6. Vehicle: Ringer's solution

Mechanism of action of local anesthesia

• Altering the basic resting potential of the nerve membrane
• Altering the threshold potential (firing level)
• Decreasing the rate of depolarization
• Prolonging the rate of repolarization

Local anesthetic agents are weak bases; they are commonly combined with a strong acid (HCl) to improve water solubility, tissue diffusibility and stability in solution. When acid is injected into the tissue, it interacts with tissue buffers, forming free base, or unionized from which permits diffusion of the anesthetic agent across the nerve membrane; where it dissociates into ionized form. It in turn interferes with the conduction of action potential along the peripheral nerve fibers by impairing the functions of sodium ion channels. Nerve impulses cannot be propagated when adequate numbers of sodium channels are not available. Recovery from nerve blockade is dependent on redistribution and metabolism of the local anesthetic solution.

Duration of Action of the Anesthetic Agent

a. The duration of action of local anesthetics is directly proportional to protein binding characteristics.
b. Agents that are highly protein bound (for example, etidocaine and bupivacaine) have the longest duration of action.
c. Those with lower protein binding capacities (for example, lidocaine and mepivacaine) have shorter durations of action.

<u>2% lignocaine 1:100,000 epinephrine:</u>

1. Onset of action: Infiltration injection ⟶ 2 minutes
   Block injection ⟶ 2-4 minutes
2. Duration of action: Infiltration injection:
   Pulpal ⟶ 1 hour
   Soft tissue ⟶ 2 $^1/_2$ hours
   Block injection:
   Pulpal ⟶ 1$^1/_2$ hour
   Soft tissue ⟶ 3-5 hours

Contraindications for Local Anesthesia

There is no absolute contraindication for local anesthesia but anesthesia maybe contraindicated due to:

1. Allergy to one of its components:
    a. Allergy to an amide group although extremely rare if occurs it does not rule out the use of another ester.
    b. Allergy to a bisulfite preservative which is used in local anesthesia with epinephrine. A local anesthetic without vasoconstrictor can be used instead.
2. A long acting local anesthetic (bupivacaine) is not recommended for children or physically or mentally disabled children due to its prolonged effect which increases the risk of soft tissue injury.
3. Prilocaine may be contraindicated in children with methemoglobinemia, sickle cell anemia, or symptoms of hypoxia or in children receiving acetaminophen or phenacetin since both medications elevate methemoglobin levels.

The maximum amount of local anesthesia that can be given is:

- Lidocaine, Mepivacaine: 4.4 mg/kg body weight
- Prilocaine: 6.0 mg/kg body weight
- Articaine: 7.0 mg/kg body weight

TECHNIQUES FOR DELIVERING LOCAL ANESTHESIA

Selection of Syringes

The American Dental Association (ADA) has established standards for aspirating syringes for use in the administration of local anesthesia. Needle selection should allow for profound local anesthesia and adequate aspiration. Larger gauge needles provide for less deflection as needle passes through soft tissues and for more reliable aspiration. The depth of insertion varies not only by injection technique, but also by the age and size of the patient. Dental needles are available in 3 lengths:

- Long (32 mm)
- Short (20 mm)
- Ultra short (10 mm)

Needle gauges range from size 23 to 30. Needles should not be bent or inserted to their hub for injections to avoid needle breakage. Regardless of the size of the needle used, it is generally agreed that the anesthetic solution should be injected slowly, and that the dentist should watch the patient closely for any evidence of an unexpected reaction.

Types of syringes

1. Metal cartridge type syringe (aspirating type):

This is a relatively safe syringe that helps prevent intravascular injections of anesthetic agent. It is used for administration of local anesthesia by two techniques; infiltration technique and block technique.

2. Jet syringe:
   It is a needleless method of depositing local anesthetic agent, primarily used for topical anesthesia. The solution is forced through a very small opening which penetrates the mucosal membrane. This method is not adequate for producing pulpal anesthesia.
   Jet injection is also used:
   a. To obtain gingival anesthesia before placement of rubber dam
   b. Removal of a loose tooth or placement of a band
   The post treatment soreness at the injected site and the associated cost are some of the disadvantages of this method.
3. Pre-sterilized disposable syringe (Disposable plastic syringe)
   It is the routinely used syringe made of plastic. It has a barrel to load the anesthetic solution and is calibrated.
4. Computer controlled local anesthetic delivery system (CCLD):
   This method enables the dentist to accurately place the needle and deliver the predetermined amount of solution through a foot activated control. The pain perceived by the patient is also reduced compared to the traditional method

ANESTHETIZATION OF TEETH AND SOFT TISSUE

Before administrating local anesthesia, an assistant should be ready to restrain hands, position the child and control movements. The assistant can also block the child's view and keep the child distracted during the procedure. A topical anesthetic should be applied and enough time should be given for its onset.

ANESTHETIZATION OF MANDIBULAR TEETH AND SOFT TISSUE

INFERIOR ALVEOLAR NERVE BLOCK
(Conventional Mandibular Block)

Indications:

1. Anesthesia for operative dentistry in all mandibular teeth.
2. Surgical procedures on mandibular teeth and supporting structures.

The supraperiosteal injection technique may sometimes be useful in anesthetizing primary incisors but it is not reliable for complete anesthesia of the mandibular primary and permanent molars.

Technique:

1. In children the mandibular foramen is located near the posterior border of the ramus. In a 3-year-old the foramen is about 5 mm from the posterior border and 20 mm from the anterior border. It is also situated at a level lower than the occlusal plane of the primary teeth of the pediatric patient. Therefore the injection must be made slightly lower and more posteriorly than for an adult patient.
2. The thumb is laid on the occlusal surface of the molar, with the tip of the thumb resting on the internal oblique ridge and the ball of the thumb resting in the retromolar fossa. Firm support during the injection procedure can be given when the ball of the middle finger is resting on the posterior border of the mandible.
3. The barrel of the syringe should be directed on a plane between the two primary molars on the opposite side of the arch.
4. It is advisable to inject a small amount of the solution as soon as the tissue is penetrated and to continue to inject minute quantities as the needle is directed toward the mandibular foramen.
5. The depth of insertion averages about 15 mm but varies with the size of the mandible and its changing proportions, depending on the age of the patient.
6. Approximately 1 ml of the solution should be deposited around the inferior alveolar nerve.

LINGUAL NERVE BLOCK

The lingual nerve can be blocked by bringing the syringe to the opposite side with the injection of a small quantity of the solution as the needle is withdrawn. If small amounts of anesthetic are injected during insertion and withdrawal of the needle for the inferior alveolar nerve block, the lingual nerve will invariably be anesthetized as well.

LONG BUCCAL NERVE BLOCK

Sometimes it is necessary to anesthetize the long buccal nerve for the removal of mandibular permanent molars (in conjunction with inferior alveolar nerve block) or for the placement of a rubber dam clamp on these teeth. A small quantity of the anesthetic solution may be deposited in the mucobuccal fold at a point distal and buccal to the indicated tooth.

All facial mandibular gingival tissue on the side that has been injected will be anesthetized for operative procedures, with the possible exception of the

tissue facial to the central and lateral incisors, which may receive innervation from overlapping nerve fibers from the opposite side.

MENTAL NERVE BLOCK

It is effective in producing anesthesia for the premolars and anterior teeth. Soft tissues of lower lip, chin, buccal soft tissues anterior to mental foramen are also anesthetized.

INFILTRATION FOR MANDIBULAR INCISORS

The terminal ends of the inferior alveolar nerves cross over the mandibular midline slightly and provide conjoined innervation of the mandibular incisors.

- A single inferior alveolar nerve block may not be adequate for operative or surgical procedures on the incisors, even on the side of the block anesthesia.
- The labial cortical bone overlying the mandibular incisors is usually thin enough for supraperiosteal anesthesia techniques to be effective.
- If only superficial caries excavation of mandibular incisors is needed or if the removal of a partially exfoliated primary incisors is planned infiltration anesthesia alone may be adequate.
- Incisor infiltration is most useful as an adjunct to an inferior alveolar nerve block when total anesthesia of the quadrant is desired. In this case the infiltration injection is made close to the midline on the side of the block anesthesia, but the solution is deposited labial to the incisors on the opposite side of the midline.

MANDIBULAR CONDUCTION ANESTHESIA (GOW-GATES MANDIBULAR BLOCK TECHNIQUE)

In 1973 Gow-Gates introduced a new method of achieving mandibular anesthesia, which he referred to as mandibular conduction anesthesia. This technique involves the following:

1. The use of external anatomic landmarks to align the needle so that anesthetic solution is deposited at the base of the neck of the mandibular condyle.
2. The external landmarks to help align the needle for this injection are the tragus of the ear and the corner of the mouth.
3. It is a nerve block procedure that anesthetizes virtually the entire distribution of the fifth cranial nerve in the mandibular area, including the inferior alveolar, lingual, buccal, mental, incisive, auriculotemporal, and mylohyoid nerves.
4. With a single injection, the entire right or left half of the mandibular teeth and soft tissues can be anesthetized, except

the mandibular incisors, which may receive partial innervation from the incisive nerves of the opposite side.

5. The needle and the barrel of the syringe should be directed toward the injection site from the corner of the mouth on the opposite side.
6. The needle is inserted just medial to the tendon of the temporal muscle and considerably superior to the insertion point for conventional mandibular block anesthesia.
7. The needle is also inclined upward and parallel to a line from the corner of the patient's mouth to the lower border of the tragus (intertragic notch).