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ANESTHESIA IN CLINICAL THERAPEUTIC DENTISTRY

Minsk BSMU 2021

МИНИСТЕРСТВО ЗДРАВООХРАНЕНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ
БЕЛОРУССКИЙ ГОСУДАРСТВЕННЫЙ МЕДИЦИНСКИЙ УНИВЕРСИТЕТ
2-я КАФЕДРА ТЕРАПЕВТИЧЕСКОЙ СТОМАТОЛОГИИ

И. А. Захарова, А. В. Бутвиловский

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Учебно-методическое пособие

Минск БГМУ 2021

УДК 616.31-085-089.5(075.8)-054.6
ББК 56.6я73
З-38

Рекомендовано Научно-методическим советом университета в качестве учебно-методического пособия 23.06.2021 г., протокол № 6

Р е ц е н з е н т ы: канд. мед. наук, доц. каф. терапевтической стоматологии Белорусской медицинской академии последипломного образования С. А. Гранько; каф. общей стоматологии Белорусской медицинской академии последипломного образования

Захарова, И. А.

З-38 Анестезия в клинике терапевтической стоматологии = Anesthesia in clinical therapeutic dentistry : учебно-методическое пособие / И. А. Захарова, А. В. Бутвиловский. – Минск : БГМУ, 2021. – 24 с.

ISBN 978-985-21-0890-4.

Изложены особенности лекарственных средств для местной анестезии, техники проведения местного обезболивания в клинике терапевтической стоматологии.

Предназначено для студентов 5-го курса медицинского факультета иностранных учащихся, обучающихся на английском языке.

УДК 616.31-085-089.5(075.8)-054.6
ББК 56.6я73

Учебное издание

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Ответственная за выпуск И. М. Семченко
Переводчики И. А. Захарова, А. В. Бутвиловский
Компьютерная вёрстка Н. М. Федорцовой

Подписано в печать 02.09.21. Формат 60×84/16. Бумага писчая «Xerox office».
Ризография. Гарнитура «Times». Усл. печ. л. 1,39. Уч.-изд. л. 1,14. Тираж 40 экз. Заказ 440.

Издатель и полиграфическое исполнение: учреждение образования
«Белорусский государственный медицинский университет».
Свидетельство о государственной регистрации издателя, изготовителя,
распространителя печатных изданий № 1/187 от 18.02.2014.
Ул. Ленинградская, 6, 220006, Минск.

ISBN 978-985-21-0890-4

MOTIVATIONAL CHARACTERISTIC OF THE THEME

According to the World Health Organization pain is defined as an "unpleasant sensation that occurs from imminent tissue damage." From a physiological perspective, pain is a warning system. During dental treatment, patients will experience pain as something unpleasant.

Total time: 65–70 minutes.

Theme of the seminar: Anesthesia in clinical therapeutic dentistry.

The problem of dealing with pain as the main reason for the formation of a negative attitude towards dental treatment is not a private matter of any dental clinic. It is one of the topical problems of modern dentistry. Ensuring full pain-free treatment during all dental procedures is compulsory for every dentist in his everyday work.

The purpose of the seminar: to summarize the knowledge about the methods and techniques of anesthesia during dental treatment procedures, principles of prevention of local anesthesia complications.

Session objectives:

1. To know the mechanism of action of local anesthetics of different groups.
2. To know the comparative description of local anesthetics.
3. To know the guide lines for the selection of drugs for local anesthesia.
4. To know the complications of local anesthesia.
5. To acquire the skills in the use of the methods and techniques of giving anesthesia.
6. To develop an algorithm of action when the signs of a side or toxics effect of the anesthetics develop.

Requirements for the initial level of knowledge:

1. The classification of dental diseases.
2. Clinical features and diagnosis of periodontal disease and tooth decay.
3. The principles of restoration and endodontic treatment.
4. X-ray signs of periodontal disease and tooth decay.
5. Development of the examination and treatment plan for patients with the diseases of hard tissues of the teeth and oral cavity.

Checklist of related disciplines:

1. Blood supply and innervation of the teeth and jaws.
2. Pathophysiology of pain (pain definition, classification of pain, the etiology of pain, neurophysiology of pain, antinociceptive system, the main categories of pain, the significance of pain for the body).
3. Pharmacodynamics of drugs used for local anesthesia.
4. Pharmacodynamics of drugs used to carry out urgent actions arising from dental care.
5. Structure of emergency conditions in outpatient dental procedures.

Test questions:

1. Chemical structure of local anesthetics.
2. Classification of local anesthetic agents.
3. Characteristics of local anesthetics.
4. Comparative characteristics of local anesthetics.
5. General rules of anesthesia.
6. Methods and techniques of giving anesthesia.

Local anesthetics are the most commonly used drugs in dental practice.

Local anesthetics are drugs that temporarily suppress the excitability of the endings of the sensory nerves and block the impulses along nerve fibers, and also can cause local or regional loss of sensitivity. They are generally very safe and allow most dental procedures to be carried out without general anesthesia.

CHEMICAL STRUCTURE OF LOCAL ANESTHETICS

Composed of 3 parts (Fig. 1):

1. The Lipophilic part: is the largest portion, aromatic, derived from benzoic acid or aniline.
2. The Hydrophilic part: is an amino derivative of ethyl alcohol or acetic acid.
3. Intermediate chain: either amide or ester linkage, determines the type of local anesthetics.

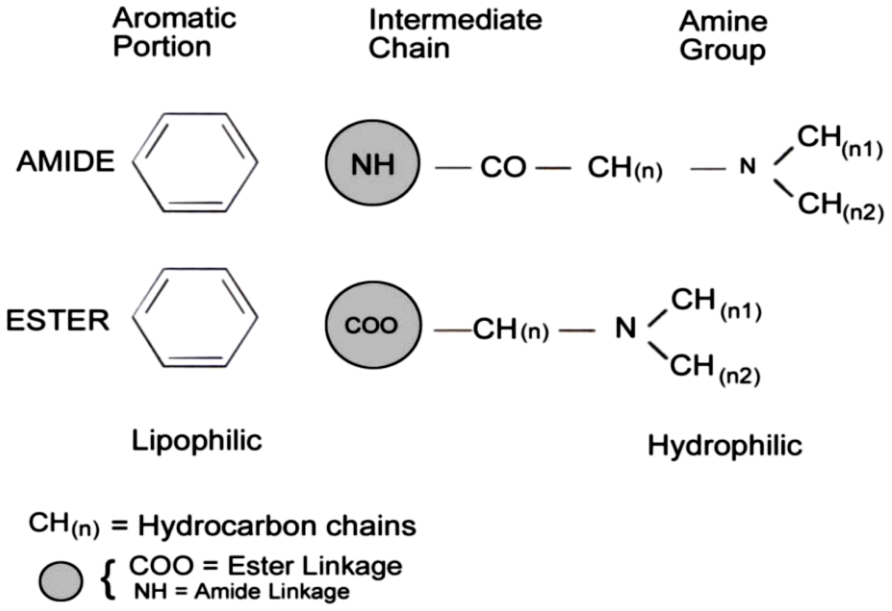

Figure 1. Local anesthetic chemical structure

Local anesthetics are weak bases, poorly soluble in water and unstable, but they combine readily with acids to form salts which are stable and water soluble. Thus, local anesthetics used for injections are dispensed as salts, most commonly the hydrochloride salts.

Local anesthetics without a hydrophilic part are not suited for injection but are good for topical applications.

Factors affecting the local anesthetic action:

– pKa;

– lipid solubility;

– protein binding;

– tissue diffusibility;

– vasodilator activity.

The effect of pH on the local anesthetic nerve blocking action:

– pKa is defined as the pH at which half of the molecules are ionized and half nonionized, it is constant and characteristic for each agent;

– most local anesthetic agents without a vasoconstrictor have a pH of 5.5–7;

– when tissue PH is below an anesthetics pKa, excess H+ is present, and the proportion of RN declines.

$$RNH+ \leftrightarrow RN + H+$$

Since RN is the form of diffusion, the effectiveness decreases.

So,

– acidification of tissues (as in infection) decreases the effectiveness;

– the closer the local anesthetic pKa to the tissue pH, the faster the onset of action.

Summary. The onset of the local anesthesia is strongly correlated with pKa of the various local anesthetics and lipid solubility. The pKa determines ionization and ionization influences on the diffusion of anesthetics across the neural membrane sheath of the nerve. The uncharged base form diffuses more quickly than the charged cationic form. The closer pKa of the local anesthesia to physiologic pH of the tissues, the more anesthetic exists in the uncharged base form. Low pKa results in a more rapid onset. It should be remembered that the onset is also reduced by increasing the solution pH.

Tasks of the local anesthesia:

– improving the quality of dental care;

– reducing the risk of general complications associated with psychoemotional stress during the dental intervention;

– solving one of the most common moral and ethical problems in dentistry — causing the patient's pain.

Properties of the local anesthesia:

– It should not be irritating to the tissue to which it is applied.

– It should not cause any permanent alteration of the nerve structure.

– Its systemic toxicity should be low.

– Time of the onset of anesthesia should be short.

– It should be effective regardless of whether it is injected into the tissue or applied locally to mucous membranes.

– The duration of action should be long enough to permit the completion of the procedure.

– It should have potency sufficient to give complete anesthesia without the use of harmful concentrated solutions.

– It should be relatively free from producing allergic reactions.

– It should be stable in solution and should readily undergo biotransformation in the body.

– It should be sterile or capable of being sterilized by heat without deterioration.

No local anesthetic in use today satisfies all of these criteria; however, all anesthetics do meet a majority of them. Research is continuing in an effort to produce newer drugs that possess a maximum of desirable factors and a minimum of negative ones.

CLASSIFICATION OF LOCAL ANESTHETIC AGENTS

They are broadly divided into two groups, i.e. the ester and amide (nonester) group.

Classification based on chemical structure:

1) Ester group:
   – Procaine;
   – Benzocaine;
   – Tetracaine;
   – Propoxycaine;
2) Amide (nonester group):
   – Lidocaine;
   – Articaine;
   – Mepivacaine;
   – Prilocaine;
   – Etidocaine;
   – Bupivacaine.

Currently, since Articaine has ester and amide bonds, there is the third group — the Amino-Ester group.

Classification based on duration of action:

1) short acting: Procaine;
2) intermediate acting: Lidocaine, Articaine;
3) long acting: Bupivacaine.

Vascular effect of local anesthetics. Local anesthetics are mostly vasodilators which decrease the duration of action:

– Procaine: the most potent vasodilator;

– Mepivacaine: the least potent vasodilator.

Central nervous system effects of local anesthetics. Local anesthetic agents readily cross the blood-brain barrier, and toxic levels can produce signs of CNS excitation and depression.

The initial symptoms of local anesthetic toxicity in man consist of a generalized feeling of lightheadedness and dizziness, followed by auditory and visual disturbances such as difficulty in focusing and tinnitus. Drowsiness, disorientation, and a temporary lack of consciousness may also occur.

Slurred speech, shivering, muscle twitching, and tremors of the face and extremities appear to be the immediate precursors of a generalized convulsive state.

A further increase in the dose of local anesthetic agents during the excitation period results in the cessation of convulsive activity, respiratory arrest, and a flattening of the brain wave pattern consistent with generalized central nervous system depression.

The signs and symptoms of CNS excitation followed by depression are related to an inhibition of cerebral cortical neurons.

An initial selective blockade of inhibitory cortical neurons or synapses allows excitatory fibers to function unopposed leading to excitation and convulsions.

Further increases in dosage depress both inhibitory and facilitatory pathways causing a generalized state of central nervous system depression.

Local anesthetic toxicity is usually due to an inadvertent rapid intravenous injection or extravascular administration of an excessive dose.

Cardiovascular effect of local anesthetics.

Hypotension: Arteriolar dilation is a result of:

– direct effect (procaine and lidocaine have the most marked effect);

– block of the postganglionic sympathetic fiber function;

– CNS depression;

– avoid adding a vasoconstrictor to preparation.

Note: cocaine is exception: produces a vasoconstriction, blocks NE reuptake.

Arrhythmias: direct effect (More resistant than CNS):

– decrease cardio excitability and contractility;

– decreased conduction rate;

– increased refractory rate (bupivacaine).

Note: cocaine is exception, it stimulates heart.

All can cause arrhythmias if concentration is high enough.

Biotransformation and excretion:

– amide local anesthetics are metabolized by the liver;

– ester local anesthetics are metabolized in plasma via pseudocholinesterase;

– procaine is hydrolyzed into PABA and diethylamine alcohol (more allergic). These both amide and ester local anaesthetics are excreted via kidneys.

Composition of the local anesthetic agent:

– Local anesthetic agent;
– Vasoconstrictor (adrenaline 1 : 100 000–1 : 200 000, 1 : 400 000);
– Reducing agent (sodium metabisulphite);
– Preservative (methylparaben);
– Fungicide (thymol);
– Vehicle (distilled water, NaCl);
– Acid or alkali to give the adjust pH.

CHARACTERISTICS OF INDIVIDUAL AGENTS

Novocaine (Procaine):

– Ester type agent, the first synthetic injectable local anesthetic
– Metabolized in plasma
– Excreted via kidneys
– Potency 1
– Toxicity 1
– Effective dental concentration of 2–4 %
– Maximum dose — 6 mg/kg

Major disadvantages:

– Long onset of action — 10 min with pKa 9.1
– Very short pulpal anesthesia duration
– Highly allergic

Indications: as a vasodilator and in patients with allergy to amide local anesthetic.

Tetracaine (Pontocaine):

– Ester type agent
– Slow onset
– Longest duration of action among esters
– 10x more toxic and more potent than procaine
– Available in injectable and topical applications

Lidocaine (Xylocaine):

– Amide type agent
– Lidocaine
– Xylocaine
– Metabolized in the liver
– Excreted via kidneys with around 10 % unchanged
– pka 7.9
– pH without a vasoconstrictor 5.5
– pH with a vasoconstrictor 3.5–4.5
– Almost no allergy
– Rapid onset of action 2–3 min

– More profound anesthesia
– Longer duration of action
– Pulpal anesthesia — 45–60 min
– Soft tissue anesthesia — 3–5 hr. low vasodilator properties
– Max dose without a vasoconstrictor — 4.4 mg/kg
– Max dose with a vasoconstrictor — 6 mg/kg
Available in many forms:
– 2 % solution ± a vasoconstrictor (1–50 000, 1–80 000, 1–10 000, 1–200 000)
– 4 % solution
– 10 % sprays
– 2 % gel
– 5 % ointment
– 2 % means 20 mg per 1 ml, so a cartridge of 1.8 ml contains 36 mg

Mepivacaine (Carbocaine):
– Amide type agent
– Metabolized in the liver
– Excreted via kidneys
– The low vasodilator
– Rapid onset of action — 2 min
– Available as 3 % or 2 % with 1 : 80000 adrenaline
– Pulpal anesthesia — 30 min
– Soft tissue anesthesia for 2–3 hours
– 3 % maximum dose is 4.4 mg/kg 3 %
– Mepivacaine is recommended in pediatric patients, geriatric patients
– Procedures not requiring long pulpal anesthesia
– Without a vasoconstrictor has only short duration of action

Prilocaine (Citanest):
– Amide type agent
– Potency 2 (compared to procaine)
– Toxicity 1 (the same as procaine)
– Metabolized primarily by the liver and sometimes by lungs and kidneys
– Excreted by kidneys
– Slower onset of action — 4 min Pulpal anesthesia 4 % (10 min)
– Pulpal anesthesia of 3 % + V.C. (60 min)
– Soft tissue anesthesia 4–5 hrs
– Max. dose of 4 % — 6 mg/kg
– Available as 4 % or 3 % + felypressin (0.03 IU/ml)
– Metabolized to o-toluidine which can cause methemoglobinemia — significant only with large doses of prilocaine
– Higher incidence of paresthesia is reported with 4 % preparation

Bupivacaine (Marcaine):
– Marcaine
– Amide type agent
– Metabolized by the liver
– Excreted via kidneys
– Potency 4 times more than lidocaine
– Toxicity 4 times less than lidocaine
– Long duration of action (and etidocaine)
– Long onset of action (6–10 min)
– 0.5 % is an effective dental concentration
– Available as 0.5 % or 0.75 % with adrenaline
– Maximum dose — 1.3 mg/kg
– Cardiotoxic (ropivacaine significantly less)
– Used in long dental procedures (pulpal anaesthesia 90 min)
– Management of postoperative pain.

Articaine (Septocaine):
– Amide type agent
– Only amide type local anesthetic that contains an ester group, therefore metabolized both in the liver and plasma
– Approved by the FDA in 2000
– Evidence points to improved diffusion through the hard and soft tissues as compared to other local anesthetics
– Reports of a higher incidence of paresthesia, presumably due to the 4 % concentration
– Not recommended for the use in children under 4 years of age

ABSOLUTE CONTRINDICATIONS FOR ANESTHESIA DRUGS OF ARTIKAINE

– allergic reactions to the components of anesthetic;
– recently suffered myocardial infarction;
– paroxysmal tachycardia and other tachyarrhythmias;
– angle-closure glaucoma;
– concomitant therapy with MAO inhibitors or tricyclic antidepressants,
– bronchial asthma with increased sensitivity to sulfites;
– severe form of the liver failure (porphyria);
– uncontrolled increase of blood pressure;
– uncontrolled hyperthyroidism;
– uncontrolled diabetes mellitus;
– pheochromocytoma (adrenal tumor);
– age of the child up to 4 years.

Table 1

Comparative Characteristics of Local Anaesthetics

	Novocaine	**Lidocaine**	**Mepivacaine**	**Articaine**
Binding to plasma proteins	5,8 %	50 %	78 %	95 %
The half-life time in minutes	–	96	114	29
Anaesthetic activity*	1	4	4	5
Toxicity*	1	2	1,7	1,5
The duration of anesthesia (min) without vasoconstrictor	15–30	30–60	45–90	60
The duration of anesthesia (min) with vasoconstrictor	30–40	120–130	120–130	180
The maximum tolerated dose (mg/kg) with vasoconstrictor	14	7	6,6	7
The maximum tolerated dose (mg/kg) without vasoconstrictor	7	4,5	4,5	5
Speed of action	Slow	Fast	Fast	Very fast

Topical local anesthesia:

– Higher concentration than injection of local anesthesia
– Provides anesthesia up to 2–3 mm depth of dry mucous membrane
– The onset of action in 1–5 minutes
– Can induce systemic toxicity
– Topical local anesthetic agents
– Lidocaine 5 %
– Benzocaine up to 20 %
– EMLA 5 %, mixture of lidocaine and prilocaine

GENERAL RULES DURING ANESTHESIA

1. Prior to the introduction of the drug collect a thorough history.
2. For anesthesia use a needle without burrs, sharpened.
3. Check the quality of the anesthetic needle connected to a syringe.
4. Ensure the needle patency.
5. After inserting the needle, it is necessary to create a depot of anesthetic.
6. Promotion of the needle deep into the soft tissues has to be preceded by the introduction of anesthetic solution.
7. When advancing the needle along the bone it must face the bone.
8. If you suspect damage to the vessel or for the prevention of introduction of anesthetic solution into the bloodstream it is necessary to perform an aspiration test.
9. Use sterile instruments and solutions in your work.
10. Before the introduction of the drug ensure its authenticity and quality.

11. In order to achieve adequate anesthesia, use a minimal amount of anesthetic.

12. Avoid an overdose of anesthetic agents.

13. Do not use different anesthetics for anesthesia in one patient.

14. Use only anesthetics approved for application in the Republic of Belarus.

The sequence steps of a local anesthesia:

1) asking the patient's history;
2) the choice of local anesthetic;
3) the determination of the place of injection and the orientation of the needle and the syringe;
4) aspiration test;
5) the injection of the anesthetic.

PHARMACOLOGY OF VASOCONSTRICTORS

Vasoconstrictors are highly valuable additions to a local anesthetic solution:

– Decrease blood flow to the site.

– Decrease rate of absorption of local anesthetic agent and lower its blood level and toxicity.

– Increase the duration of action of the local anesthetic agent.

– Decrease bleeding and achieve hemostasis at the site.

Types of vasoconstrictors:

1. Catecholamine:
   – Epinephrine;
   – Norepinephrine;
   – Dopamine.
2. Non-catecholamine:
   – Amphetamine;
   – Ephedrine.
3. Felypressin (synthetic analogue).

Dilution of vasoconstrictors. Concentration:

– 1 : 100000 = 0.01 mg/ml;
– 1 : 200000 = 0.005 mg/ml;
– 1 : 400000 = 0.0025 mg/ml (Ubistesin, 3M).

BASICS OF TECHNIQUE

Use a sterilized sharp needle.

The flow of local anesthetic solution. After properly loading the cartridge into the syringe, to ensure a free flow of anesthetic solution when it is injected into the target area a few drops of local anesthetic solution should be ousted from the cartridge. The anesthetic cartridge stoppers are made of a silicone rubber to ensure the ease of administration. A few drops of the solution are recommended to be expelled from the needle to determine if a free flow of solution exists.

Determine whether or not to warm the anesthetic cartridge or syringe. The cartridge is stored at room temperature (approximately 72 °F, 22 °C). There is no reason for the warming of the local anesthetic cartridge before its injection into target tissues.

The patient position. The patient should be in a physiologically sound position before and during the injection. Common faint (vasodepressor syncope — the most commonly seen medical emergency in dentistry), most often occurs before, during, and, on occasion, immediately after administration of local anesthesia. It is a temporary cerebral ischemia secondary to vaso-vagal over activity, in response to stress. This result in the bowling of the blood in the venous compartment of the circulation, this mean there is insufficient blood return to the heart from the venous system. This lead to insufficient stroke volume and inadequate volume of oxygenated blood supply to the brain.

Dry the tissue. The site of needle penetration should be dried with A 2 × 2 inch gauze to remove any gross debris. The lip retraction is necessary for visibility and accessibility to obtain adequate visibility during the injection, it should be dried to make retraction easier too.

Apply topical disinfectant (antiseptic — optional). A reasonable topical sterile oro-base antiseptic to be can be used, after the tissues had been dried, this decreased the risk of introducing septic materials into the soft tissues, producing either infection or inflammation. Antiseptics include Alcohol-containing antiseptics, Merthiolate (thimerosal) and Betadine (povidone-iodine) can cause soft tissue dryness and burn; these should be avoided.

Topical anesthetic. After the topical antiseptic application, the topical anesthetic can be applied. Application of excessive amounts of topical anesthetic on large areas of soft tissues, may produce undesirably wide areas of anesthesia, an unpleasant taste, and, perhaps even more importantly, with some topical anesthetics (such as lidocaine), a rapid absorption into the cardiovascular system (CVS), theoretically, may be leading to higher local anesthetic blood levels and an increased risk of overdose.

Reassure and communicate with the patient. To place a concrete idea in the patient's mind concerning the upcoming injection and dental procedures.

Establish a firm hand rest (a firm hand rest is necessary). It is essential to maintain complete control over it at all times of injection procedure. The types of hand rest vary according to the practitioner's physical abilities. Any finger or hand rest that permits the anesthetic syringe to be stabilized without increasing the risk to a patient is acceptable. Two techniques to be avoided are using no syringe stabilization of any kind and placing the arm holding the syringe directly on the patient's arm or shoulder Hand position for injection:

a) palm-down: poor control over the syringe, not recommended;

b) palm-up: better control over the syringe because it is supported by the wrist; recommended;

c) palm up and finger support: greatest stabilization; highly recommended.

Make the tissue taut. The tissues at the site of needle penetration should be stretched before insertion of the needle. This can be accomplished in all areas of the mouth except the palate (where the tissues are naturally quite taut). Stretching of the tissues permits the sharp stainless steel needle to cut through the mucous membrane with a minimum of resistance. The loose tissues, on the other hand, are pushed and torn by the needles as it is inserted, producing more discomfort on injection and more postoperative soreness.

Keep the syringe out of the patient's line of sight. With the tissue prepared and the patient positioned, the assistant should pass the syringe to the administrator behind the patient's head or across and in front of the patient but below the patient's line of sight (less preferred). A right-handed practitioner administrating a right-side injection can sit facing the patient or, if administering a left-side injection, facing in the same direction as the patient.

Insert the needle into the mucosa. With the needle bevel properly oriented (see specific injection technique for bevel orientation; however, as a general rule the bevel of the needle should be oriented toward bone), insert the needle gently into the tissue at the injection site (where the topical anesthetic was placed) to the depth of the bevel. With a steady hand rest and adequate tissue preparation, this potentially traumatic procedure is accomplished without the patient ever being aware of it.

Slowly deposit the local anesthetic solution. With the needle in position at the target area and aspirations completed and negative, the administrator should begin pressing gently on the plunger to start administering the predetermined (for the technique) volume of anesthetic. Slow injection is vital for two reasons: of utmost significance is the safety factor, slow injection also prevents the solution from tearing the tissue into which it is deposited. Rapid injection results in immediate discomfort (for a few seconds) followed by a prolonged soreness when the action of the local anesthetic is terminated. Slow injection is defined as the deposition of 1 ml of local anesthetic solution in not less than 60 seconds. Therefore, a full 1.8-ml cartridge requires approximately

2 minutes. Through slow deposition, the solution is able to diffuse along normal tissue planes without producing postoperative discomfort.

Communicate with the patient. The patient should be communicated with during deposition of the local anesthetic. Most patients are accustomed to receiving their local anesthetic injections rapidly. Statements such as, "I'm depositing the solution (or I'm doing this) slowly so it will be more comfortable for you, but you're not receiving any more than is usual" go far to allay a patient's apprehension at this time.

Slowly withdraw the syringe. After completion of the injection, the syringe should be slowly removed from the soft tissues and the needle made safe by drawing its protective sheath over it (safety syringe) or by capping it immediately with its plastic sheath via the scoop technique.

Observe the patient. After completion of the injection, the doctor should remain with the patient while the anesthetic begins to take effect (and its blood level increases). Most adverse drug reactions, especially those to interiorly administered local anesthetics, develop either during the injection or within 5 to 10 minutes of completion of the injection.

Record the injection on the patient's chart. An entry must be made of the local anesthetic drug used, vasoconstrictor used (if any), dose (in milligrams) of the solution(s) used, the needle(s) used, the injection(s) given, and the patient's reaction. For example, on the patient's dental progress notes the following might be inscribed: R-IANB, 25-long, 2 % lidocaine + 1 : 100 000 epinephrine, 36 mg. Tolerated procedure well.

Techniques of local anesthesia:

– local infiltration technique;

– nerve block technique.

LOCAL INFILTRATION TECHNIQUE

The Infiltration Technique is the most commonly used injection when anesthetizing the teeth of the maxilla for dental procedures. The Infiltration Technique can also be utilized successfully in other areas where the bone overlying the roots of the teeth to be anesthetized is thin and porous such as the mandibular incisors. The Infiltration Technique can successfully anesthetize the mandibular molars for minor procedures in most pediatric patients due to the porosity of the bone. The success of the technique depends on diffusion of the local anesthetic through the periosteum, cortical plate and cancellous bone to reach the dental plexus of nerves supplying the targeted tooth to be anesthetized. The point of injection for the Infiltration Technique is in the alveolar mucosa just above the mucogingival line. However, visualizing the root length on the x-ray is recommended to account for patient variation in root length.

Technique:

– The mucous membrane is dried and topical anesthetic placed in the vestibule of the area to be injected.

– The tissues are then pulled taut to expose the injection site above the targeted injection area.

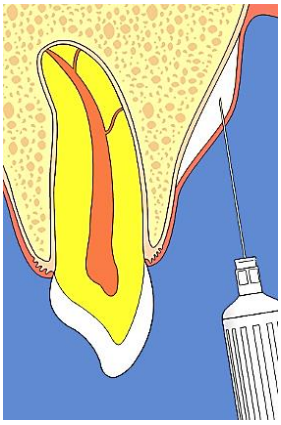

Figure 2. The infiltration technique

– The needle is inserted through the alveolar mucosa just above the mucogingival line at the height of the muccobuccal fold with the bevel of the needle oriented toward bone (Fig. 2).

– After initial penetration of the needle, pause and deposit a few drops of anesthetic solution and wait a minimum of 5 seconds before advancing the needle.

– The needle is advanced slowly in small incremental steps parallel to the long axis of the targeted tooth injecting a few drops of local anesthetic at each step.

– The depth of injection is usually only a few millimeters. When the tip of the needle approximates the apical $^1/_3$ of the tooth, the needle should be reoriented horizontally so that the periosteum is lightly contacted.

– Aspiration is performed and $^1/_2$ milliliter ($^1/_3$ of a cartridge) of local anesthetic is injected slowly over 1–2 minutes so as to avoid discomfort and dispersion of the anesthetic solution.

– The syringe is then withdrawn and treatment can begin almost immediately, as pulpal and soft tissue anesthesia is already complete.

Contraindications:

1. Infection or acute inflammation in the area of injection.

2. Dense bone covering the apices of teeth (can be determined only by trial and error. This is most likely over the permanent maxillary first molar in children, its apex lies beneath the zygomatic bone, which is relatively dense).

Failure of Anesthesia

1. Depositing anesthetic solution below the apex of a maxillary tooth results in excellent soft-tissue anesthesia but poor or absent pulpal anesthesia.

2. The needle tip lies too far from the bone (solution deposited in the buccal soft tissues).

REGIONAL NERVE BLOCK

In this technique anesthetic solution is deposited near the nerve trunk at a distance from the working site. This is commonly used for mandibular teeth as for maxillary teeth the local infiltration usually works.

For nerve block anesthesia, the local anesthetic solution is deposed within close proximity to a main nerve trunk, ensuring local anesthesia within the supply area of this nerve distal to the injection site.

This technique is used for local anesthesia of the inferior mandibular nerve, the lingual nerve, the buccal nerve, the greater palatine nerve and the nasopalatine nerve (Fig. 3).

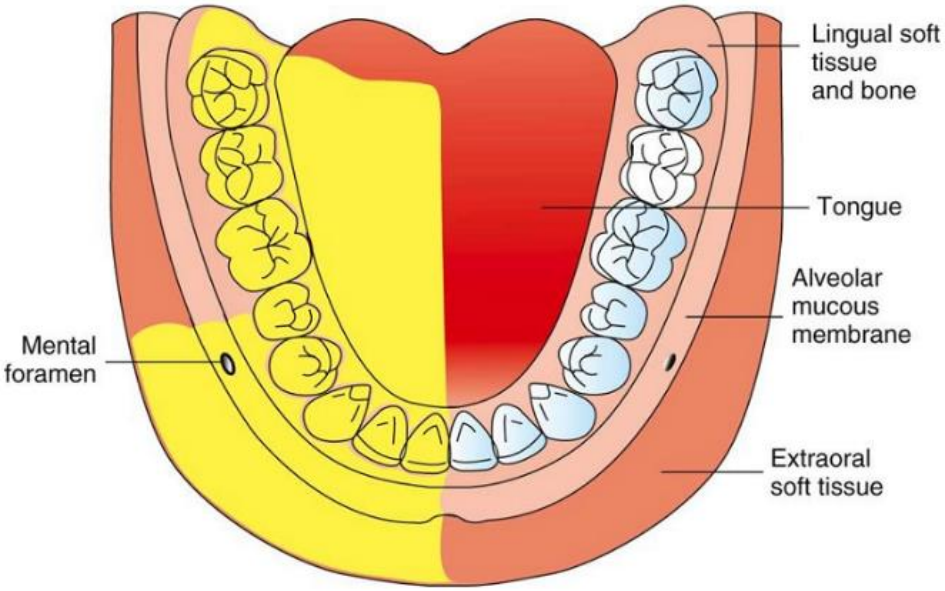

Figure 3. Area anesthetized by an inferior alveolar nerve block

Nerve block anesthesia is indicated in cases, where insufficient depth of anesthesia is reached with the infiltration technique, for example if the tooth is surrounded by a compact bone layer preventing the local anesthetic from reaching the site of action in sufficient concentration.

Advantages are complete local anesthesia, long duration of action and a comparatively low dose.

Disadvantages are an increased risk damage of the nerve trunk and an accidental intravascular injection of the local anesthetic solution.

MANDIBULAR ANESTHESIA

The basic point of injection is pterygomandibular plica. At wide-open mouth of a patient the syringe is placed at the level of at premolar (first molar) on the opposite side of the mandible. The site of injection is the outer slope of the fold on the border of the lower and middle third part of it. The needle is advanced into contact with the bone (Fig. 4), and then the syringe is transferred to premolars of the anesthetized part and the needle is advance along the bone to a depth of 1.5–2 cm.

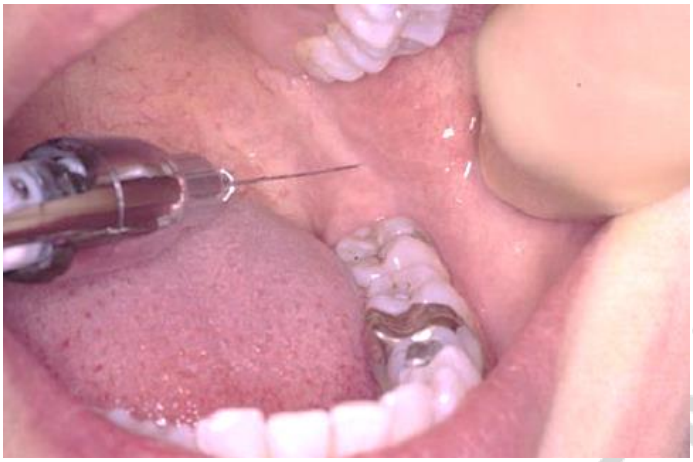

Figure 4. Mandibular anesthesia

Contraindications: infection or acute inflammation in the area of injection.

Failure of Anesthesia:

– It is not uncommon.

– Greater success rate than IAN block with slower time of onset and less aspiration percentage.

SUPPLEMENTAL INJECTION TECHNIQUES

– Intraosseous Anesthesia (IO).

– Periodontal Ligament Injection/ Intraligamentary Injection (PLD).

The PDL injection also may be used successfully in the maxillary arch; however, with the ready availability of other highly effective and atraumatic techniques, such as the supraperiosteal (infiltration) injection, and drugs such as articaine HCl to provide single-tooth pulpal anesthesia, there has been little compelling reason for use of the PDL in the upper jaw (although there is absolutely no other reason not to recommend it in this area). Possibly the greatest potential benefit of the PDL injection lies in the fact that it provides pulpal and soft tissue anesthesia in a localized area (one tooth) of the mandible without producing extensive soft tissue (e.g., tongue and lower lip) anesthesia as well. Virtually all dental patients prefer this technique to any of the "mandibular nerve blocks". In a clinical trial, Malamed reported that 74 % of patients preferred the PDL injection primarily because of its lack of lingual and labial soft tissue anesthesia.

Areas Anesthetized. Bone, soft tissue, and apical and pulpal tissues in the area of injection (Fig. 5).

Indications:

1. Pulpal anesthesia of one or two teeth in a quadrant.

2. Treatment of isolated teeth in two mandibular quadrants (to avoid bilateral IANB).

3. Patients for whom residual soft tissue anesthesia is undesirable.

4. Situations in which regional block anesthesia is contraindicated.

5. As a possible aid in the diagnosis of pulpal discomfort.

6. As an adjunctive technique after nerve block anesthesia if partial anesthesia is present.

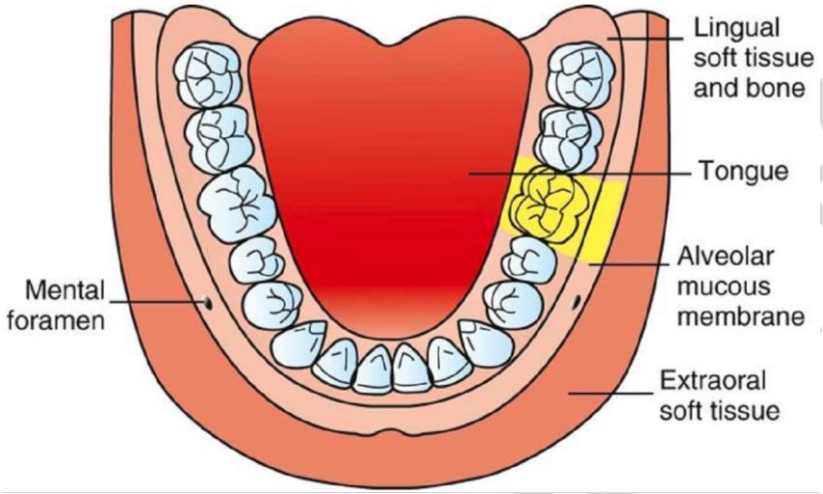

Figure 5. Area anesthetized by a periodontal ligament injection

Contraindications:

1. Infection or inflammation at the site of injection.

2. Primary teeth when the permanent tooth bud is present:

a) Enamel hypoplasia has been reported to occur in a developing permanent tooth when a PDL injection was administered to the primary tooth above it.

b) There appears to be little reason for use of the PDL technique in primary teeth because infiltration anesthesia and the incisive nerve block are effective in primary dentition.

3. Patient who requires a “numb” sensation for psychological comfort.

Advantages:

1. There is no anesthesia of the lip, tongue, and other soft tissues, thus facilitating treatment in multiple quadrants during a single appointment.

2. Minimum dose of local anesthetic necessary to achieve anesthesia (0.2 mL per root).

3. An alternative to partially successful regional nerve block anesthesia.

4. Rapid onset of profound pulpal and soft tissue anesthesia (30 seconds).

5. Less traumatic than conventional block injections.

6. Well suited for procedures in children, extractions, and periodontal and endodontic single-tooth and multiple-quadrant procedures.

Disadvantages:

1. Proper needle placement is difficult to achieve in some areas (e.g., distal of the second or third molar).

2. Leakage of local anesthetic solution into the patient's mouth produces an unpleasant taste.

3. Excessive pressure or overly rapid injection may break the glass cartridge.

4. A special syringe may be necessary.

5. Excessive pressure can produce focal tissue damage.

6. Postinjection discomfort may persist for several days.

7. The potential for extrusion of a tooth exists if excessive pressure or volumes are used.

Technique PLD:

1. A 27-gauge short needle is recommended.

2. ***Area of insertion:*** long axis of the tooth to be treated on its mesial or distal root (one-rooted tooth) or on the mesial and distal roots (of multirooted tooth) interproximally (Fig. 6).

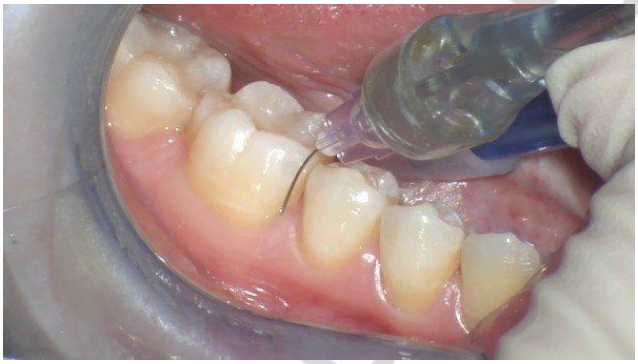

Figure 6. Area of insertion for a periodontal ligament injection

3. ***Target area:*** depth of the gingival sulcus

4. Landmarks:

a) root(s) of the tooth;

b) periodontal tissues.

5. ***Orientation of the bevel:*** although not significant to the success of the technique, it is recommended that the bevel of the needle face toward the root to permit easy advancement of the needle in an apical direction.

6. Procedure:

a) Assume the correct position. (This varies significantly with PDL injections on different teeth.) Sit comfortably, have adequate visibility of the injection site, and maintain control over the needle. It may be necessary to bend the needle to achieve the proper angle, especially on the distal aspects of second and third molars.

b) Position the patient supine or semisupine, with the head turned to maximize access and visibility.

c) Stabilize the syringe and direct it along the long axis of the root to be anesthetized.

(1) The bevel faces the root of the tooth.

(2) If interproximal contacts are tight, the syringe should be directed from the lingual or buccal surface of the tooth but maintained as close to the long axis as possible.

(3) Stabilize the syringe and your hand against the patient's teeth, lips, or face.

d) With the bevel of the needle on the root, advance the needle apically until resistance is met.

e) Deposit 0.2 mL of local anesthetic solution in a minimum of 20 seconds.

(1) When using a conventional syringe, note that the thickness of the rubber stopper in the local anesthetic cartridge is equal to 0.2 mL of solution. This may be used as a gauge for the volume of local anesthetic to be administered.

(2) With a PDL syringe, each squeeze of the "trigger" provides a volume of 0.2 ml.

f) There are two important indicators of success of the injection:

(1) Significant resistance to the deposition of local anesthetic solution

(a) This is especially noticeable when the conventional syringe is used; resistance is similar to that felt with the nasopalatine injection and is thought to be the reason for reports of PDL injections being painful.

(b) The local anesthetic should not flow back into the patient's mouth. If this happens, repeat the injection at the same site but from a different angle. Two tenths of a milliliter of solution must be deposited and must remain within the tissues for the PDL to be effective.

(2) Ischemia of the soft tissues adjacent to the injection site. (This is noted with all local anesthetic solutions but is more prominent with vasoconstrictor-containing local anesthetics.)

g) If the tooth has only one root, remove the syringe from the tissue and cap the needle. Dental treatment usually may start within 30 seconds.

h) If the tooth is multirooted, remove the needle and repeat the procedure on the other root(s).

MAXIMUM DOSE OF LOCAL ANESTHETICS

Due to the systemic toxic effects of local anesthetics and vasoconstrictors, maximum or limit doses have to be followed. However, the indicated maximum doses should be considered

Benchmarks rather than absolute values. It is strongly recommended to use the smallest possible volume of solution which will lead to an effective anesthesia and to evaluate the condition of the patient before any injection.

The recommended max. Doses are based on the expected serum concentrations of the substances concerned, the systemic toxic threshold dose, the extrapolation of animal and clinical studies, as well as on the evaluation of reported side effects.

Therefore, under normal conditions no systemic toxic effects have to be expected, if the recommended max. Doses are considered. However, due to the patient's individual range of variation, as well as absorption, distribution, and metabolization of the local anesthetic, toxic reactions may also occur within the so-called safe dosage range. In particular, there is an increased risk in case of quick resorption, accidental intravasal injection, or a reduced threshold dose of the patient.

The doses of local anesthetic drugs are presented in terms of milligrams of drug per unit of body weight.

Table 2

Maximum Dose of Local Anesthetics

	Without Vasoconstrictor		**With Vasoconstrictor**	
	mg/kg	**mg/70 kg**	**mg/kg**	**mg/70 kg**
Articaine	4	300	7	500
Lidocaine	4	300	7	500
Mepivacaine	4	300	7	500

For healthy adults, the maximum dose of epinephrine as a vasoconstricting additive is 200 μg.

For patients with coronary heart disease or other serious cardiovascular diseases, the maximum dose is reduced to 40 μg.

Most commercial local anesthetics are combined preparations consisting of a local anesthetic substance and a vasoconstrictor. For both components, different maximum doses are applicable.

Therefore, in individual cases, the dose is determined or limited by the local anesthetic or the vasoconstrictor.

Conclusions: Articaine is currently the best active substance for local anesthetic as it is well tolerated and it gives a profound analgesic effect.

– Articaine anesthesia occurs rapidly — within 0.3–3 min;

– Articaine 5 times stronger novocaine and 2 times stronger lidocaine;

– Articaine — slightly toxic drug as compared to other anesthetics;

– Articaine — the safest drug for pregnant women and patients.

Comrade with concomitant diseases of the cardiovascular system in comparison NIJ with other anesthetics.

Good local and systemic tolerance of articaine and relative absence of side effects in 99.4 % of cases.

All of the above makes it possible to dispense the anesthetic in a significantly smaller volume and, hence, a smaller dose of the drug that reduces the possibility of complications.

CONCLUSION

Anesthesia is one of the most important functions of a dentist which is a professional and ethical problem. Giving anesthesia is far from satisfactory, and therefore most of the population is afraid of dental procedures. With this in mind, the problem of anesthesia can be regarded as a kind of common professional and ethical problems in dentistry. There are, however, individual approaches each dentist uses, depending on his skills and knowledge. Thus, it is well known that one dentist treats without pain, and another attempts to avoid it if possible. But along with the fact that an individual approach to pain management issues means a lot, the doctor's function, however, is to provide absolutely painless dental procedures. This is the doctor's duty. If it is not fulfilled ethical professional problems may arise. They consist in the fact that the doctor intentionally causes pain to the patient. The patient complains of pain, expresses his valid claims to the doctor, conflicts can arise so that the patient does not trust the doctor, the patient is afraid of the doctor. In the end, the damage is caused to the patient's health. Thus, it is obvious that this problem should be solved by anesthesia.

RECOMMENDED READING

1. *Borchard, U.* Pharmacology of articaine and of vasoconstrictive additives / U. Borchard. Bad Nauhen. 1989. P. 13–29.

2. *Calvey, T.* Principles and Practice of Pharmacology for Anaesthetists / T. Calvey, N. Williams. Oxford, Blacwell Scientific Publications, 1991. P. 236.

3. *Jastak, J.* Local anesthesia in the oral cavity / J. Jastak, J. Yagiela, D. Donaldson // Saunders company. 1995. P. 339.

4. *Kirch, W.* Die klinische Phaarmakokinetik von Articain nach introraler intramuskularer / W. Kirch, N. Kitteringham, G. Lambers // Mschr. Zahnheilk. 1983. № 93. P. 714–719.

5. *Malamed, S.* Handbook of local Anaesthesia / S. Malamed. St. Louis : Mosby-Year Book, 1990.

6. *Malamed, S.* Future trends in local anesthetic drugs / S. Malamed // International Congress of Modern Pain Control. 1991.

7. *Worner, H.* Dental local anesthesia, side effects and errors in administration / H. Worner. Bad Nauheim. 1990. P. 123–129.

8. *Chestnutt, I. G.* Clinical Dentistry / I. G. Chestnutt, J. Gibson. 3rd ed. Churchill's pocketbooks, 2007. P. 91–100.

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ISBN 978-985-21-0890-4