LOCAL ANESTHESIA IN DENTISTRY

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METHODS OF PAIN CONTROL

- *local anesthetic agents*
- *inhalation sedation*
- *antianxiety agents*
- *intravenous sedation*
- *general anesthesia*

LOCAL ANESTHESIA

- *most frequently used in dentistry*
- *local anesthesia temporarily blocks the normal generation and conduction action of the nerve impulses*
- *local anesthesia is obtained by injecting the anesthetic agent near the nerve in the area intended for dental treatment*
- *produce loss of sensation to pain in a specific region without the loss of consciousness*

DEFINITION OF LOCAL ANESTHETICS

The term is used to describe compounds, which in a suitable form and appropriate dose applied to the skin or mucous membranes (surface analgesia), injected locally into the tissue near the peripheral nerve or for the nerve, interrupts impulse conduction in this nerve, preventing receiving and conduction of centripetal impulses in a limited area.

DEFINITION OF LOCAL ANESTHETICS

- *as a result of occuring a local anesthesia processes the incoming information do not reach the pain centers of the brain cortex, receiving conscious experience of pain*
- *effect is reversible, anesthesia persists differently long, depending on the properties of the compound, rate of absorption, metabolism and excretion*

DEFINITION OF LOCAL ANESTHETICS

- *used even in small concentrations, can cause damage to the nerve fibers causing them irreversible changes*
- *they differ substantially from analgesics, whose mechanism of action is associated with influence on the specific structures of the central nervous system*
- *ensure the perform of procedures with full consciousness of patient, which allows to keep permanent contact with him*

EFFECTS OF LOCAL ANESTHETICS

- *analgesia*
- *weakness of tension of striated muscles (relaxatio)*
- *weakness of vegetative reflexes (hyporeflexio)*

DESIRABLE PROPERTIES OF ANESTHETICS

- *good solubility in water and body fluids*
- *good penetration into the tissue*
- *the stability of the structure despite of the sterilization processes*
- *rapid, reversible and sufficient long action*
- *large therapeutic spread*
- *minimal toxicity, no general adverse effects*
- *substance and its metabolites should not produce allergy*
- *nonirritating to the tissues in the area of the injection*
- *action limited to pain fibers*

MECHANISM OF ACTION

- *stabilization of cell membranes*
- *inhibition of depolarization and generation of action potential*
- *preventing the conduction of active state in nerve fibers*

MECHANISM OF ACTION

- *inhibition of penetration of sodium ions into the cell, the main process of conditioning depolarization*
- *inhibiting the release of calcium ions from storage locations in the cell*

Inflamed tissue has a lower pH (5.0-5.5), thus responds poorly to anesthesia carried out by substances that are weak bases.

ORDERING OF INHIBITION OF NERVE FIBERS

- *sympathetic fibers*
- *fibers conducting sensation of cold*
- *fibers conducting pain sensation*
- *fibers conducting touch*
- *fibers conducting deep feeling*

ORDERING OF INHIBITION OF NERVE FIBERS

- *the sensitivity of individual types of cells and nerve fibers is different*
- *is due to the thickness of the fibers - the most sensitive are the thinnest fibers*
- *in mixed sensory fibers are inhibited in the following order:*
  - ✓ *fibers conducting pain sensation*
  - ✓ *fibers conducting temperature*
  - ✓ *fibers conducting touch*

TYPES OF LOCAL ANESTHESIA INJECTIONS

- *topical*
- *infiltration*
- *block anesthesia*
- *periodontal ligament*

TYPES OF LOCAL ANESTHESIA INJECTIONS

- *topical anesthesia provides a temporary numbing effect on nerve endings that are located on the surface of the oral mucosa*
- *supplied as:*
  - *ointments*
  - *liquids*
  - *sprays*

TYPES OF LOCAL ANESTHESIA INJECTIONS

- *infiltration is achieved by injecting the solution directly into the tissue at the site of the dental procedure*
- *most frequently used in maxillary teeth*
- *used as a secondary injection to block gingival tissues surrounding the mandibular teeth*

TYPES OF LOCAL ANESTHESIA INJECTIONS

Block anesthesia

- *the solution is injected near a major nerve, and the entire area served by that nerve is numbed*
- *required for most mandibular teeth*

TYPES OF LOCAL ANESTHESIA INJECTIONS

Inferior alveolar nerve block

- *injecting the anesthetic solution near the branch of the inferior alveolar nerve close to the mandibular foramen*
- *type of injection for half of the lower jaw, including the teeth, tongue, and lip*

TYPES OF LOCAL ANESTHESIA INJECTIONS

Incisive nerve block

- *injection given at the site of the mental foramen*
- *used for mandibular anterior teeth or premolars*

TYPES OF LOCAL ANESTHESIA INJECTIONS

Periodontal ligament

- *alternative infiltration anesthesia method - anesthetic solution is injected directly into the periodontal ligament and surrounding tissues*

LOCAL ANESTHETIC CAUTIONS

- *injection into a blood vessel*
- *infected area*
- *localized toxic reaction*
- *systemic toxic reaction*
- *temporary numbness*
- *paresthesia*

DURATION OF ACTION

Length of time from induction until the reversal process is complete.

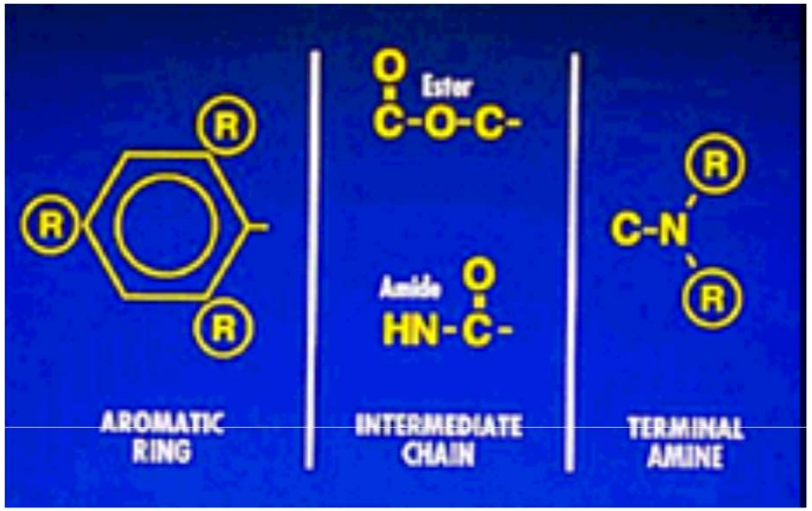
- *short-acting:*
  - *local anesthetic agent lasts less than 30 minutes*
- *intermediate-acting:*
  - *local anesthetic agent lasts about 60 minutes*
- *long-acting:*
  - *local anesthetic agent lasts longer than 90 minutes*

LOCAL ANESTHETICS MOLECULES

- *all LA's are amphipathic*
- *molecules have lipophilic and hydrophilic characteristics*
- *classes are amides and esters*
  - *amides: metabolised in liver*
  - *esters: metabolised in plasma*
- *esters are more likely to cause allergic reaction*
- *very few ester local anesthetics in use today*

LOCAL ANESTHETICS MOLECULES

- *chemical structure of local anesthetics have an amine group on one end connect to an aromatic ring on the other*



LOCAL ANESTHETICS MOLECULES

- *The amine end is hydrophilic (soluble in water), anesthetic molecule dissolve in water in which it is delivered from the dentist's syringe. It's also responsible for the solution to remain on either side of the nerve membrane.*
- *The aromatic end is lipophilic (soluble in lipids). Because nerve cell is made of lipid bilayer it is possible for anesthetic molecule to penetrate through the nerve membrane.*
- *The trick the anesthetic molecule must play is getting from one side of the membrane to the other.*

FACTORS AFFECTING LOCAL ANESTHETICS

- *Increasing the lipid solubility leads to faster nerve penetration, block sodium channels, and speed up the onset of action.*
- *The more tightly local anesthetics bind to the protein, the longer the duration of onset action.*
- *LA's have two forms, ionized and nonionized. The nonionized form can cross the nerve membranes and block the sodium channels. So, the more nonionized presented, the faster the onset action.*
- *Decrease in pH shifts equilibrium toward the ionized form, delaying the onset action.*

FACTORS AFFECTING LOCAL ANESTHETICS

- *vasocontriction prolongs the duration of an anesthetic agent by decreasing the blood flow in the immediate area of the injection*
- *decreases bleeding in the area during surgical procedures*
- *short-lasting drugs by themselves*
- *most frequently epinephrine, also levonordefrin (α-methylnorepinephrine), felypressin (non-catecholamine)*

CONTRAINDICATIONS FOR THE USE OF VASOCONSTRICTORS

- *unstable angina*
- *recent myocardial infarction*
- *recent coronary artery bypass surgery*
- *untreated or uncontrolled severe hypertension*
- *untreated or uncontrolled congestive heart failure*
- *hyperthyreosis*
- *epilepsy*

TOXIC EFFECTS OF LOCAL ANESTHETIC

- *is proportional to the quantity of agent introduced into the body*
- *the result of an overdose*
- *cumulation of the drug*
- *disturbances of excretion*
- *sensitiveness*
- *toxicity increases in geometric progression*

Comparison of forms of local anesthetics overdose

Cause of overdose	The beginning and the severity of symptoms	The duration of symptoms	The main methods of preventing
Intravascular injection – often	seconds!!! the most intensified	2 - 3 minutes	aspiration and slow injection
Too high a dose - the most often	5 – 30 min the gradual onset with increasing intensity	5 - 30 minutes	the administration of minimum doses
Slow biotransformation - rarely	1 – 3 hours the gradual slow onset	potentially long	appropriate assessment of the patient
Slow elimination - the least often	several hours	potentially the longest	appropriate assessment of the patient

TOXIC EFFECTS OF LOCAL ANESTHETIC - SYMPTOMS

- *anxiety, somnolence*
- *vertigo, tremor of muscles*
- *enhanced muscle tension*
- *vomiting*
- *breathing and circulation disturbances, including the cardiac arrest and breathing*

TOXIC EFFECTS OF LOCAL ANESTHETIC

- *central nervous system*
- *autonomic ganglia*
- *neuromuscular junction*
- *cardiovascular system*
- *system of smooth and striated muscle*

TOXIC EFFECTS TO THE CENTRAL NERVOUS SYSTEM

- *initially stimulating effect*
- *anxiety*
- *tremor progressing to convulsions*
- *after a period of strong stimulation, occurs CNS depression, sometimes leading to death due to INHIBITION OF RESPIRATORY CENTER!*

TOXIC EFFECTS TO THE CARDIOVASCULAR SYSTEM

- *reduce the conduction in the electrical conduction system of the heart*
- *reduce myocardial irritability*
- *reduce the contractile force of cardiac muscle*

Local anesthetics can cause anaphylactic shock!

ANAPHYLACTIC SHOCK - PREVENTION

- *is recommended to perform test of sensitization, especially in patients with suspected allergic interview*

ANAPHYLACTIC SHOCK - PREVENTION

- *conjunctival test:*
  - ✓ *1-2 drops of 1% solution into the conjunctival sac - the result after 5-10 min*
- *nasal test:*
  - ✓ *2-3 drops of 1% solution into the nasal cavity - acceleration pulse of 10/min after 15 min (positive test)*
- *subcutaneous test:*
  - ✓ *0.1 ml of a 1% solution subcutaneously in the arm and the result is read after 20-30 min (redness and swelling - positive test)*

TREATMENT OF POISONING LOCAL ANESTHETIC AGENTS

- *interval in the administration of the drug*
- *horizontal position of the patient*
- *unblocking and maintaining patency of the airway*
- *potential application of oxygen*
- *in the event of cardiac and respiratory arrest, lead resuscitation according to the general rules*

TREATMENT OF POISONING LOCAL ANESTHETIC AGENTS

- *hypersensitivity manifested local allergic reaction or asthma attack or anaphylactic shock*
- *convulsions, breathing problems and low blood pressure should be treated:*
  - ✓ *oxygen*
  - ✓ *intravenous infusion fluids*
  - ✓ *benzodiazepines (diazepam) – very carefull*
  - ✓ *suxamethonium (succinylcholine) – 0,1-0,5 mg iv*

TREATMENT OF POISONING LOCAL ANESTHETIC AGENTS

- *should not be administered any centrally acting stimulants (analeptics)*
- *anaphylactic shock should be treated according to the rules proceedings in emergency situations*

PHENTOLAMINE MESYLATE (ORAVERSE®)

- *alpha-adrenergic receptor antagonist*
- *local anaesthetic reversal agent for adults and children*
- *designed to reverse the local vasoconstrictor properties used in many local anesthetics to prolong anesthesia*
- *accelerate the reversal of the lingering soft-tissue numbness*
- *administered via standard dental cartridge in dose 0,4 – 0,8 mg*
- *it will be injected into the same site as the local anesthetic was previously deposited*
- *reduces duration of anaesthesia by 50%*

DEVELOPMENT OF GENERAL AND LOCAL ANESTHESIA

- *took place in Western Europe from 1750 to 1850*
- *chemists and physicians collected sample of coca leaves for experiments*
- *isolated active principle of coca leaf, synthesized to a drug for patients to feel more relief of pain when taking surgeries*
- *in 1860, German chemist Albert Niemann successfully isolated the active principle of coca leaf; he named it cocaine*

DEVELOPMENT OF GENERAL AND LOCAL ANESTHESIA

- *Niemann discovered the effect of numbness of the tongues caused by alkaloid in 1860*
- *based on Niemann's discovery, Russian physician Basil Von Anrep did experiments on animals, such as rats, dogs, and cats*
- *he injected small quantity of 1% solution to his tongue; tongue became insensitive*
- *he concluded cocaine is a good drug for surgical anesthetic*
- *William Steward Halsted and Richard John Hall developed the inferior dental nerve block techniques for dentistry*
- *sensory nerve blockade was first described by Halsted in 1884*

DEVELOPMENT OF GENERAL AND LOCAL ANESTHESIA

- *more physicians began to do research of cocaine in the clinic trials*
- *the physician Sigmund Freud used the stimulant effect of cocaine to treat the morphine addiction in patients*
- *an ophthalmologist Carl Koller realized the importance of the alkaloid's anesthetic effect on mucous membranes*
- *in 1884, he used the first local anesthetic on a patient with glaucoma*
- *Freud, Halsted, and Koller became addicted to the drug through self-experimentation*

SIDE EFFECTS OF COCAINE

Minor:

- *addiction*
- *intoxication*

Severe:

- *death*

PROCAINE REPLACED COCAINE

Procaine replaced cocaine

- *in 1898, Professor Heinrich Braun introduced procaine as the first derivative of cocaine, also known as the first synthetic local anesthetic drug*
- *trade name is Novocaine®.*

PROCAINE PROBLEMS

- *took too long to set (i.e. to produce the desired anesthetic result)*
- *wore off too quickly, not nearly as potent as cocaine*
- *classified as an ester; esters have high potential to cause allergic reactions*
- *caused high concentration of adrenaline, resulted in increasing heart rate, make people feel nervous*
- *today, procaine is not even available for dental procedures*

LIDOCAINE

- *in 1940, the first modern local anesthetic agent was lidocaine*
- *belongs to the amide class, cause little allergenic reaction; it's hypoallergenic*
- *sets on quickly and produces a desired anesthesia effect for several hours*

LIDOCAINE

- *effect four times stronger and 2 times longer than procaine*
- *anesthesia occurs quickly (after 30 – 60 s) and lasts for 30 - 60 minutes*
- *effective in all types of local anesthesia*
- *the addition of vasoconstrictor causes significant prolongation of the action (approximately 50%)*
- *at one time should not exceed a dose of 200 mg (3 mg/kg bw) and with the addition of vasoconstrictor a dose of 500 mg (7mg/kg bw)*

EXPRESSING A % SOLUTION IN MG/ML

- *Example: 2% lidocaine*

$$2\% = 20\ mg/ml$$

- *1 cartridge has 1.8 ml of fluid*

$$\frac{20\ mg}{1\ ml} = \frac{X}{1{,}8\ ml}$$

$$X = 1{,}8 \times 20\ mg = 36\ mg\ of\ drug/cartridge$$

PRILOCAINE

- *less toxic than lidocaine*
- *anesthesia occurs very quickly (after 2 min) and lasts longer than after lidocaine (about 2 hours)*
- *for all types of anesthesia, and can be used in combination with vasoconstrictor (epinephrine, felypressin)*
- *a single dose should not exceed 8 mg/kg bw*

MEPIVACAINE

- *chemical structure and pharmacological properties like lidocaine*
- *anesthesia occurs quickly (after 3-5 min) and lasts for 90 - 150 minutes*
- *to infiltration is used in a concentration of 0.5 - 1%, to nerve blockade 2 - 3%*
- *a single dose should not exceed 7mg/kg bw*
- *the addition of epinephrine only slightly longer duration of action, but reduces the side effects*
- *used especially when there are contraindications to the use of vasoconstrictors*

BUPIVACAINE

- *synthetic long-acting amide local anesthetic agent*
- *also shows a analgesic activity - is used to treat pain e.g. during childbirth, in the postoperative period*
- *effects on sensory fibers is stronger than motor fibers*
- *anesthesia occurs after 1– 10 min and lasts for 3 - 8 hours - onset and the time of action depends on the dose and the type of anesthesia*
- *can be used in combination with vasoconstrictor (epinephrine)*
- *maximum single dose is 2 mg/kg*

ARTICAINE

- *quickly and potent anesthetic*
- *gives the deeper and stronger anesthesia than lidocaine at a dose reduced by half*
- *used in combination with vasoconstrictor (epinephrine)*
- *anesthesia occurs quickly (after 1-3 min) and lasts for 45 - 240 minutes – it depends on concentration of epinephrine*
- *a single dose should not exceed 7mg/kg bw (with epinephrine)*
- *used in infiltration and block anesthesia*

INHALATION SEDATION

- *Nitrous oxide/oxygen (N_2O/O_2) is a combination of these gases that the patient inhales to help eliminate fear and to help the patient relax*
- *History - dates back to 1844*
  - *dr. Horace Wells first used it on his patients*
- *Effects*
  - *non addictive*
  - *easy onset, minimal side effects, and rapid recovery*
  - *produces stage I anesthesia*
  - *dulls the perception of pain*

CONTRAINDICATION OF USING N2O/O2

- *pregnancy: first trimester*
- *nasal obstruction: problems inhaling through the nose*
- *emphysema: increased O_2*
- *multiple sclerosis: breathing difficulties*
- *emotional stability: altered perception of reality*

EXPOSURE TO NITROUS OXIDE

- *used only for patient treatment*
- *never administered for recreational purposes*
- *how to reduce N_2O hazards to dental personnel*
  - *use a scavenger system*
  - *use a patient mask that fits well*
  - *discourage patients from talking*
  - *vent gas outside the building*
  - *routinely inspect equipment and hoses for leaks*
  - *use an N_2O monitoring badge system*

PATIENT PREPARATION FOR INHALATION SEDATION

- *review health history*
- *obtain base-line vital signs*
- *describe the procedure of administering the gases*
- *describe the use of the mask and the importance of nasal breathing*
- *describe the sensations that the patient will experience*
- *reassure the patient*

ANTIANXIETY AGENTS

- *for the relief of anxiety*
- *sedatives*
- *criteria for use:*
  - *patients are very nervous about a procedure*
  - *procedures are long or difficult*
  - *mentally challenged patients*
  - *very young children requiring extensive treatment*

SEDATIVES

- *Commonly prescribed:*
  - *alprazolam*
  - *clorazepate dipotassium*
  - *chlordiazepoxide HCl*
  - *diazepam*
  - *lorazepam*
  - *oxazepam*
  - *bromazepam*

INTRAVENOUS SEDATION

Antianxiety drugs that are administered intravenously continuously throughout a procedure at a slower pace, providing a deeper stage I analgesia.

INTRAVENOUS SEDATION

- *Patient assessment*
  - *a health history, physical examination, and signed consent are performed*
  - *baseline vital signs are taken and recorded*
  - *oximetry and electrocardiogram are completed and recorded*
  - *weight taken and recorded for dose determination*

INTRAVENOUS SEDATION

- *patient monitoring*
- *physiologic measurements taken and recorded every 15 minutes*
  - *level of consciousness*
  - *respiratory function*
  - *oximetry*
  - *blood pressure*
  - *heart rate*
  - *cardiac rhythm*
- *most often used drugs – midazolam, propofol, ketamine, opioids*

GENERAL ANESTHESIA

A controlled state of unconsciousness in which there is a loss of protective reflexes, including the ability to maintain an airway independently and to respond appropriately to physical stimulation or verbal command.

This controlled state in loss of consciousness, produces stage III general anesthesia.

GENERAL ANESTHESIA

Pharmacologic make-up

- *combination of gases*
  - N_2O/O_2
  - *halothane or enflurane mixtures*
- *intravenous agents such as thiopental sodium and methohexital sodium*