RISK FACTORS WHILE PERFORMING LOCAL ANESTHESIAIN DENTAL PRACTICE

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Abstract

According to the statistical data at least 30% of outpatients suffer from general somatic diseases in a compensated form. Dental care of such patients might result in various complications. Besides, main category of such patients is the persons with risk factors, such as: age factor (in pediatric and geriatric patients), factors arising during pregnancy and lactation and simultaneoustherapy with various other drugs. All these patients belong to a risk group. For the safest and adequate treatment of this contingent, the most important factor is to get detailed information about complete case history. Everyday practice shows the importance of the problem related to local anesthesia in the risk group patients. The most problematic issue is the correct selection of anesthetic agents.

Keywords: Local anesthesia, risk factors, risk group patients, dental care

Introduction

The main way to control dental pain in today's dental practice is a local anesthesia.The safety of a pain reliever is dependent on the methods of applying it, as well as, on the thorough selection of an anesthesia medication. The problem arises and is actually dependent on frequent administration of anesthetic injections, while the number of dental patients with general somatic diseases is also very high. The term "Risk Group Patients" refers not only to the patients with chronic somatic pathologies, but also to the patients with various other risk factors. So, anesthetic procedures to such patients should be carried out with caution.

According to statistical data 30% of the patients visiting dental ambulatory suffer from various general somatic diseases in a compensation phase. Anesthetic medications may lead such patients to some complications in the period of treatment, as well as, in the post treatment period (6).

One of the most important factors which ensure an adequate and safe treatment of Risk Group Patients is collecting complete general anamnesis

(11).Besides, it is of great importance to take into consideration physicochemical features, pharmacocinetic and pharmacodynamic characteristics, side effects, and adverse reactions of the components of localanesthetics.

Risk Factors of Local Anesthesia

While selecting tactics for local anesthesia, we should take into consideration the following risk factor groups:

1. Local anesthesia may result in general types of complications in the process of treatment in patients with co-existing diseases and pathological conditions:

- Cardiovascular pathologies (cardiac ischemia, myocardial infarction, heart failure, hypertension, post-stroke conditions, heart arrhythmia);
- Hypotension;
- Allergic status;
- Bronchial asthma;
- Status epilepticus;
- Thyreotoxicosis;

2. Local anesthesia may induce general complications later, after the treatment in patients with co-existing diseases and pathological conditions:

- Diabetes;
- Rheumatoid arthritis, rheumatism;
- Liver pathologies;
- Kidneypathologies;
- Immunodeficiency conditions, malignant tumors;
- Glaucoma;

3. Co-administered medication therapy;

4. Risk factors, which require thorough selection of special dental treatment tactics:

- Emotional lability;
- Age factor;
- Pregnancy;
- Lactation;

In this article we will not analyze co-existing pathologies, but the above mentioned risk factors.

Fear and Anxiety– a Problem in Dental Practice

Approximately 99.5% of outpatient dental treatments are carried out under preservedconsciousnessandas a rule it is associated with pain or other negative reactions.Psychogenic Reactions Anxiety-induced events are by far the most common adverse reactions associated with local anesthetics in

dentistry. These may manifest in numerous ways, the most common of which is syncope. In addition, they may present with a widevariety of symptoms, including hyperventilation, nausea, vomiting and alterations in heart rate or blood pressure. Psychogenic reactions are often misdiagnosed as allergic reactions and may also mimic them, with signs such as urticaria, edema and bronchospasm (7).

Homeostatic changes in dental patients under emotional stress are nearly the same asin patients experiencing stress before abdominalsurgeries.Fainting (syncope) occurs in average 2 % of dental patientscaused by thefears to dental manipulations, the cause of which is psycho-reflexive vascular crisis (10).

Pre-operation stress causes changes in heart contraction force, rhythm, heart rate, respiration rate and arterial pressure. Skin temperature may also change.**Physiologic data changes under emotional stress may be as follows: heart contraction and respiration rate may increase 2.5 -3 times and arterial pressure 10-20mm, dental boring machine sounds may increase heart contraction ratefor 10-15 beats per minute** (10).

Emotional stress may increase skin galvanic reflex, sweat secretion, glucose and histamine level in blood, skin electrical resistance, and also oral dryness, diarrhea, changes in blood count may occur.Stressful emotions may affect pituitary gland, adrenal gland, and the sympathoadrenal system. Thus epinephrine, norepinephrine and corticosteroidlevels in blood and urine may be significantly higher than normal.Changes of hormonal levels, gaseous exchanges, and hemodynamics are a problemfor a dentist andmay induce some complications.The degree of surgery risk is increased (especially when there are cases of cardiovascular pathologies, bronchial asthma, endocrinopathy, psychosis).Tooth extraction operation is usually followed by high arterial blood pressure in patients suffering from cardiovascular pathologies. According to ECG (the electrocardiogram) a hypoxia of cardiac muscle develops, which is similar to the hypoxia observed in patients at an early stage of myocardial infarction. In 5-6 hrs after the operation arterial pressure elevates again. At this stage ECG reveals a coronary failure picture. All the above mentioned factors trigger the development of pathologic conditions under the general somatic risk-factors. This condition requires from a dentist to select efficient premedications in order to ensure prevention of stressful conditions and in case of urgency, to carry out pre-hospital emergency care.

Selection of Local Anestheticsfor the Pediatric Dental Patients

To ensure adequate pain management in children and to prevent general toxic reactions, it is recommended to use the most up-to-date, efficient, and safe pain medications. In order toavoid toxic effects it is

important to pay attention tothe speed of the injecting procedures of the local anestheticagent. **Speed at which the medications are to be administeredis 1ml of anesthetic over a period of 1 minute!!!**The reason of systemic toxic reactions caused by local anesthetic overdose may occur if we do not take into consideration the pediatric patient's age and weight. This type of complications in pediatric patients occurs with inexperienceddentists when they carry out treatment in all four quadrants simultaneously.

Tab.1 Recommended Dosage of Local AnestheticAgentsfor Pediatric Patients (Malamed, 1997)

Age of the Pediatric Patient	Recommended dose of Local Anesthetic Solutions
One-year-old	0.25 ml
Two-year-old	0.3-3.4 ml
Three-year-old	0.4-0.5 ml
Four- year-old	0.5 ml
Five- year-old	0.6 ml
Six- year-old	0.6-0.8 ml
Seven- year-old	0.8-1 ml
Eight- year-old	1-1.5 ml

Selection of Local Anesthetics for the Elderly Dental Patients

A safe selection of local pain medications in the elderly patientsis associated with several age-related metabolic changes, cardiovascular and respiratorysystem failure compensation abilities, and also liver and kidneysdysfunctions.

To select local anestheticsin the elderly patients great attention should be paid to age-related disorders, cardiovascular and respiratory system compensation failure, and also liver and kidney dysfunctions. After 30 years of age human body physiological functions begin to reduce about 1% a year, i.e. at the age of 70 metabolism decreases up to 60%. This factor slows down drug metabolism and excretion processes. Because of lack of abilities to bind drug to plasma proteins, the drug may accumulate and circulate in blood in high concentrations(3).

In the elderly age organ systems may have the following changes:

- Insufficiency of the cerebral circulation and oxygen metabolism;
- Flexibility of arterial system is degraded due to sclerosis;
- Vitalcapacity of lungs is decreased causing saturationreduction;
- The weight of the kidneys, as well as blood delivery to the kidneys, is decreased; especially renal corticalperfusion is diminished, which results in diminished glomerular filtration and failure of functional reserves;
- Liver weight and perfusion is decreased, enzyme synthesizing process is reduced;

- Drug Metabolism is worsened and excretion of medications is delayed, the level of plasma proteins decreases and most of the administered medications remain active. The reason is not only the plasma protein deficiency, but also the factthat some of the proteins have already been bound to other medications, which is taken by the patient as a treatment for general somatic pathologies. With age reduced drug metabolism period starts and drug excretion ability decreases. Due to the above mentioned, free unbound fractions of medications in blood flow can inducegeneral toxic effects (2).

Tab. 2 Recommended Doses of Local Anesthetic Medications in Elderly (Geriatric) Patients(Malamed, 1997)

Desired duration of anesthesia	Local anesthetic medication for single injection
Up to 15 min	3% epinephrine-free mepivacaine 4% epinephrine -free articaine
Up to 30-45 min	4% articaine with epinephrine n 1:200000 2% mepivacaine with epinephrine 1:200000

Toxicity of Local Anesthetics

Toxic reactions induced by anesthetic drug overdose may appear when the medication accumulates in blood plasma, CNS (central nervous system), or endocardium andwhen it reaches such critical point that a patient's life is endangered (5).

The reason may be as follows:

- Rapid intravascular administration of the injection;
- Excessive doses of the medication;
- Disorders in bio-transformation processes of the drug;
- Disorders in drug eliminations from the body;

According to the widely accepted data, anesthesia drug overdose may cause a number of side effects – loss of consciences, breath suppression, tremor, generalized convulsion, nausea, vomiting. Using anesthetic drugs according to recommended doses is relatively safe in today's dental practice (except in case of allergic reactions). Caution should be taken to select an individual dose for a patient, taking into account the weight of the patient's body. e.g.: maximum permissible dose of **articaine** with a vasoconstrictor for an adult patient is 7mg/kg. So, if a patient weighs 70kg, maximum permissible dose will be 500mg which equals to 7 carpules of4% **articaine** (1carpule contains 1.7 - 1.8 anesthetic solution).

Special caution should be taken with patients who have over-weight pathologies, elderly patients, pregnant and breast-feeding patients. It is desirable to use minimal doses of anesthetic injections. **It is recommended**

to use 1/2 or 1/3 of the maximum permissible dose in a dental ambulatory.

Tab.3 Maximum Permissible Doses of Anesthetic Substances (Malamed, 1997)

Anesthetic medication	Maximum Permissible Dose	
	With vasoconstrictor	Vasoconstrictor free
novocain	14	7
lidocaine	7	4.4
mepivacaine	6.6	4.4
prilocaine	8 (5- in children)	6
articaine	7 (5- in children)	5

Selection of Local Anesthetics for the Pregnant and Breast-feeding Dental Patients

According to statistic data, 5% of congenital anomalies of a fetus are causedby medications. Medication penetration through placental barrier is dependent not only on physicochemical features of the medication, but also on placenta's conditions. So, while treating a pregnant patient, we should take into account the fact that most of the medication substances can penetrate placental barrier and that their inactivation, release elimination speed in an embryo and fetus is not so high. This may have an undesirable effect on the fetus (4). During the period of pregnancy the amount of blood flow circulation and glomerular filtration increases, liver enzymes are highly activated, which may affect medication metabolism and elimination processes, i.e. pharmacokinetics. Consequently it changes medication activity and toxicity.

During pregnancy period the ability of medications to bind to plasma proteins is lowered resulting in accumulation of free fractions in the blood flow. Low concentrations of plasma proteins in a fetus blood diminishes the tissue ability to bindmedication substances, which generates high risk of free fractional concentrations, as well as the risk of damaging a fetus.

Risk factors of treating the patients in the pregnancy and lactation period that may appear as the cause of undesired effects in a fetus and a newborn are as follows:

- I and III trimesters of pregnancy;
- Age of a pregnant: under 16 and over 40;
- Complications in obstetrical-gynecological anamnesis;
- Somatic pathologies in the anamnesis, especially that of the liver and the kidneys;
- Pregnancy-induced pathologies ;
- Overdose of anesthetic medications;
- Special characteristics of mental status of a patient; (4)

In the sense of phetotoxic effects, lipid solubility of an anesthetic drug (which ensures proper distribution of the medication in the fetus body) and its ability to bind to plasma proteins (as only free fractions of medication passes placental barrier) is of great importance.(11).For example, the ability of lidocaine to bind to plasma proteins is 77% and articaine's ability is 95%. Consequently, in case of high lipid solubility coefficient (46.4), 23% of administered lidocaine will appear in a fetus body. And, in case of articaine, as its lipid solubility coefficient equals 17, only 5% of the administered medication passes placental barrier. As articaine's ability to bind to plasma proteins is high, 95 % of the medication remains in blood circulation and the bond ensures the medication to appearpharmacologically inactiveand its low lipid solubility results in its reducedpenetration ability through tissue membranes.So, when selecting local anesthetic medications for pregnant and nursing patients, we should selecta medication which has a high ability of binding to proteins and a low coefficient of lipid solubility. **According to experimental researches, articaine is considered to be the best choice in breast-feeding patients, as this medication has not been discovered in mother's milk in clinically unacceptable concentrations.**

As to the vasoconstrictors, from systemic pharmacological effects of **epinephrine** that are undesirable for pregnant patients we should point out the following:

- Stimulation of tonic myometrial contractions:
- High level of sugar in blood;
- Increased heart rate;
- High arterial pressure;

The above mentioned characteristics of ephinefrine, limits the use of articaine with ephinefrine to some extent. In this case, the best choice will be anesthetic agent with mepivacaine because of its vasoconstrictive features, as it does not need to be used with adrenaline. It should be noted that anesthetic injections containing felipressine is not acceptable to be used in pregnant patients because it stimulates the labor process (9). Overdose of anesthetic medications during pregnancy may result in breath suppression in a newborn infant, and the use of prilocaine and novocaine may lead to methemoglobinemia (4).

Conclusion

The factors to Be Considered in Outpatient Dental Treatment with Anesthesia

1. To determine functional conditions of a patient;
2. To ensure premedication;
3. To plan appropriate dental care;

4. After carrying out all the manipulations, to keep a close eye ona patient and to give all the necessary recommendations;

The factors to Be Considered in Pediatric and Adult Dentistry

- The use of vasoconstrictors is not acceptable in children under 5;
- Vasoconstrictor (epinephrine) concentration in children above 5 must not exceed 1:200000; The use of articaine is not acceptable in children under 4. It is highly recommended to use relatively safe anesthetics, such as, medications based on articaine, mepivacaine, lidocainewhich are to be used considering the age and body weight of a child.

The Factors to Be Taken into Consideration When Selecting Anesthetic Medications for Elderly Patients

- Possible disorders of local anesthetic injection pharmacodynamics in geriatric patients;
- Interaction of anesthetic drugs with other medications;
- Selection of anesthetic drugs should be carried out in consideration with the patient's general conditions and co-existing pathologies;
- It is highly recommended to use anesthetic agents without vasoconstrictors, or if necessary only optimal amount of concentration to be used – 1:200000.

When using amidic anesthetic medications in geriatric patients, there is great probability the so-called delayed drug elimination to occur, due to age-related dysfunctions of kidneys and liver.On the other hand, estericgroup drug metabolism and excretion, most likely will not be changed as Pseudocholinestherase activity does not change with age.

As to articaine, it belongs to amidic anesthetics, which contains esteric group as well. Esteric bond splits in blood faster, than in the liver. Approximately 90 % of administered articaine is transformed with blood esterases, and its half-life time is (t ½)-22min, which is the shortest time among amidic anesthetics and it does not change with age.(8).

Maximum recommended dose of epinephrine in healthy patients should not exceed 40mcg/kg (8 ml solution 1:200000), and in risk group elderly patients 20mcg/kg (4 ml solution 1:200000). If themanipulation and trauma volumeand the duration of surgicalintervention allows, it would be better to use anesthetic solutions without vasoconstrictors.

In order to prevent reactions induced by anesthetic agents, the following rules of medication administration should be kept:

- Overdose of drug delivered into the body, which was induced by intravascular delivery of the medication, may be avoided by carrying out

aspiration. Delivery speed is of great importance. Maximum recommended delivery speed equals 1 ml / min;

- It is recommended to useminimum effective doses of medications, which is enough for specific techniques;
- It is recommended to use medications including vasoconstrictors, except the case when we have fundamental reason to say no to vasoconstrictors;
- We should take into consideration maximum recommended doses, which is individual in each case and should be determined according to the weight of the patient's body;

In case of routine treatment in pregnant patients, 14 – 28 week of pregnancy period is the best time for treatment. In this period organogenesis of a fetus is completed, placenta is almost formed, hemodynamics is stable at some extent, and immunological status is improved. It should be noted that I and III trimesters of pregnancy are considered to be "critical" when the risk of miscarriage andpretermlabor is very high.

Emergency dental care in pregnant patients should be carried out at any time of pregnancy, taking into consideration existing pathologies and a patient's allergic status. In any case dental care should be performed in absolutely painless conditions, with appropriate anesthetic medications, if necessary premedication and psychotherapeutic care also should be carried out. (4).

Pain thresholdin pregnant women is rather low, than in normal conditions. So, using diazepam group medications with analgesic drugs ensures vegetostabilizing and analgesic effects. Adequate premedication ensures safe and high quality dental care. **In pregnant and nursing patients the use of local anesthetic containing articaine with optimal concentration ofepinephrine (1:200000) is relatively safe (10).**

References:

Malamed, Stenley F. Handbook of Local Anesthesia.Edition 6, 2012.

Veerin B. Pharmacological Aspects of Local Anaesthetics in the Elderly, Anesthesiology, Leiden University Medical Center, Leiden, The Netherlands, P. 49–52 | Vol. V. №1, 2011.

List V. Anesthesia for the elderly, 2007. http://www.it-medical.ru/index.php?option=com_mtree&task=rate&link_id=34&Itemid=33.

Rabinovich S. A., Zoryan E. V., Nosova-Dmitriyev S. A. Justification of medicinal therapy at treatment of dental diseases in pregnant women and nursing mothers, the Attending doctor. - 2005. - N 1. - P. 62-68. - Bibliogr.: page 68.

Malamed S. Allergic and toxic reactions to local anesthetics. Clinical stomatology. 2004, N 4.
Shaida L.P., et al. Carrying out local anesthesia in patients of group of risk. Dentistry Today. 2002.#6(9).
A. Haas, BSc, DDS, BScD, Ph, FRCD(C), An Update on Local Anesthetics in Dentistry • 2002.
Kirh W., Ortel R. Local anesthesia at elderly patients during dental interventions, 2001.
Malamed S. Possible complications at a local anaesthesis.//Clinical Dentistry. No 1, 2000.
Rabinovich S. A. Modern technologies of local anesthesia in dentistry. Moscow, 2000.
Zoryan E. V., Rabinovich S. A., Anisimova E. N., Lukyanov M. V. Features of rendering the stomatologic assistance to patients with risk factors: Methodical recommendations. Moscow, Ministry of Health of the Russian Federation, 1999. - 44 p.