

## Analysis Of Hemodynamic Parameters Using Various Methods Of Local Anesthesia During The Treatment Of Mandibular Molars

Análisis de parámetros hemodinámicos mediante varios métodos de anestesia local durante el tratamiento de molares mandibulares

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### Abstract

The article is devoted to the analysis of hemodynamic parameters in patients with chronic pulpitis of the mandibular molars using the method of spring anesthesia developed by P. M. Egorov and the method of intra-bone anesthesia performed using an automated device "Anesto RA-5". Examination and endodontic treatment of chronic pulpitis of the same group of lower jaw teeth in 120 patients aged 30 to 65 years, which was carried out taking into account the general somatic and dental status, the state of the cardiovascular system and blood circulation in the process of performing local anesthesia. The study revealed significant differences in the effectiveness and safety, depending on the method of local anesthesia. The most significant differences were found for such indicators as the timing of the onset of anesthesia, the complete absence of pain during the administration of the anesthetic solution, short-term and long-term side effects. An increase in systolic blood pressure, heart rate, and a decrease in stroke blood volume were expressed in patients with conducting anesthesia. The use of intraosseous anesthesia using the device "Anesto RA-5" showed that the deviations of the circulatory system parameters were less pronounced compared to the indicators for conducting anesthesia. The use of intraosseous anesthesia does not threaten the health of patients, requires emergency pharmacological action

**Keywords:** conductor anesthesia, intraosseous anesthesia, hemodynamic parameters, mandibular molars

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### Resumen

El artículo está dedicado al análisis de los parámetros hemodinámicos en pacientes con pulpitis crónica de los molares mandibulares utilizando el método de anestesia de resorte desarrollado por PM Egorov y el método de anestesia intraósea realizado mediante un dispositivo automatizado "Anesto RA-5". Examen y tratamiento endodóncico de pulpitis crónica del mismo grupo de dientes del maxilar inferior en 120 pacientes de

30 a 65 años, que se llevó a cabo teniendo en cuenta el estado somático y dental general, el estado del sistema cardiovascular y la circulación sanguínea. Se controló el proceso de realización de la anestesia local. El estudio reveló diferencias significativas en la eficacia y seguridad, según el método de anestesia local. Las diferencias más significativas se encontraron para indicadores como el momento del inicio de la anestesia, la ausencia total de dolor durante la administración de la solución anestésica, los efectos secundarios a corto y largo plazo. En los pacientes sometidos a anestesia se expresó un aumento de la presión arterial sistólica, la frecuencia cardíaca y una disminución del volumen sanguíneo sistólico. El uso de anestesia intraósea con el dispositivo "Anesto RA-5" mostró que las desviaciones de los parámetros del sistema circulatorio eran menos pronunciadas en comparación con los indicadores para realizar la anestesia. El uso de anestesia intraósea no amenaza la salud de los pacientes, requiere una acción farmacológica de emergencia.

**Palabras clave:** Anestesia Conductora, Anestesia Intraósea, Parámetros Hemodinámicos, Molares Mandibulares

## Introduction

Analgesia of the teeth on the lower jaw in connection with the known anatomical and physiological features presents significant difficulties <sup>1-3</sup>. The peculiarity of the anatomical structure of the lower jaw is that the outer and inner surfaces of the body of the lower jaw consist of dense layers of compact matter, which practically has no holes. Under these conditions, the diffusion of local anesthetic solutions deep into the bone tissue to the optic nerves is difficult <sup>4-6</sup>. In addition, at everyday dental appointments, especially in persons with initial background pathology of internal organs, there are frequent manifestations of circulatory disorders, which should be taken into account when performing local anesthesia <sup>7-9</sup>.

Conductor methods of analgesia have traditionally been effective in the treatment of lower molars. However, they are quite complex in execution, which is associated with individual features of the structure of the maxillofacial region <sup>10</sup>, and are also accompanied by numerous side effects and complications that may require special treatment, including inpatient care and surgical intervention <sup>10,11</sup>.

One of the areas that opened new perspectives in improving the quality of local anesthesia, including intraosseous, is the introduction of tools, devices and machines, providing the highest quality of anesthesia in dentistry, the Optimal level of local anesthesia in the treatment of pulpitis can be achieved when used in dental practice automated device "Anesto RA-5" <sup>12, 13, 14, 15</sup>, adapted to the implementation of intraosseous anesthesia with a number of advantages.

## Materials and Methods

In the period from 2015 to 2020, at the clinical base of the Department of General Practice Dentistry of the Belgorod State National Research University, a survey and endodontic treatment of chronic pulpitis of the chewing group of the lower jaw teeth was conducted in 120 patients aged 30 to 65 years.

The criteria for inclusion in the study were as follows: the presence of chronic pulpitis of the chewing group of the lower jaw teeth; consent to participate in the study and the processing of personal data; patients of both sexes aged 25 to 66 years; low effectiveness of previous therapy; no contraindications to the prescribed therapy.

To select the optimal method of local anesthesia for the endodontic treatment of mandibular pulpitis in all 120 patients, the state of blood circulation was studied using a Goldway G30 heart monitor and an EXEL computer table that allows determining the main indicators of central and peripheral hemodynamics at the stages of anesthesia and treatment using formulas.

In patients with background pathology, diseases of the cardiovascular system and blood circulation, including general atherosclerosis, cardio-sclerosis, coronary heart disease, and arterial hypertension, prevailed. All patients were in a state of stable compensation.

In accordance with the applied methods of anesthesia, 120 patients who agreed to participate in the study were divided into two groups.

The first control group consisted of 58 people who had endodontic treatment of the chewing teeth of the lower jaw in chronic pulpitis under conducting anesthesia. The second, main group, consisted of 62 patients. In them, the preparation of the teeth of the lower molars was performed under intra-bone anesthesia using an electronic device "Anesto RA-5".

In each of the clinical groups, two subgroups were identified, depending on the state of health of the patients, somatically healthy and with background pathology.

The distribution of patients in the clinical groups and subgroups was uniform, without any significant quantitative and qualitative differences in age, gender, and the presence of background pathology. Allergic diseases and any manifestations of allergy were not detected in the patients.

The examination of patients was carried out in two directions: the first included the study of the general somatic and dental status, and the second-a multi – factor assessment of the state of the cardiovascular system and blood circulation during local anesthesia and preparation of teeth for the filling stage.

The protocol of the clinical study of patients met the modern requirements concerning the implementation of standardized diagnostic and treatment programs in patients with a dental profile.

To study changes in hemodynamic parameters during the course of local anesthesia options and preparation of teeth for endodontic treatment, a protocol for a targeted study of patients was developed.

One of the possibilities for obtaining sufficiently complete information about the state of hemodynamics is the calculation method using certain formulas. A condition that significantly increases the clinical signifi-

cance of methods for studying blood circulation is the possibility of implementing the calculated method in the form of computer programs with obtaining information in real time.

The list of the main indicators of central and peripheral hemodynamics, including those calculated by formulas, and necessary for assessing the state of blood circulation during local anesthesia and dental treatment, is given in Table 1, where the first three parameters are determined by the hardware method, the rest are calculated by formulas using the EXEL spreadsheet. After the initial hemodynamic data and the patient's age are entered into the EXEL spreadsheet, the full set of indicators is determined on the computer screen almost instantly.

Hardware parameters (systolic and diastolic pressure, heart rate) were obtained using the Goldway G30 heart monitor. designed for measuring and recording the bioelectric potentials of the heart, heart rate, blood pressure, oxygen saturation of arterial blood hemoglobin (saturation), pulse rate, body temperature ( $t^{\circ}$ ), monitoring on the monitor screen of the electrocardiogram, values and graphs of the measured parameters of the patient's condition.

In accordance with the purpose and objectives of the study, the determination of blood circulation indicators was carried out at the following four stages: before the introduction of a local anesthetic solution; immediately after the introduction of an anesthetic; after the onset of anesthesia; after the end of treatment.

**Table 1.** The studied parameters of blood circulation in the dynamics of local anesthesia

| Indicators                                   | Research method and formula                                                            |
|----------------------------------------------|----------------------------------------------------------------------------------------|
| 1. Systolic blood pressure, ADs              | Hardware, device «Goldway G30»                                                         |
| 2. Diastolic blood pressure, ADd             | Hardware, device «Goldway G30»                                                         |
| 3. Heart rate, HR                            | Hardware, device «Goldway G30»                                                         |
| 3. Pulse pressure, PD                        | $PD = ADs - ADd$                                                                       |
| 4. Average dynamic pressure, SDD,            | $SDD = ADs + 0,43(ADs - ADd)$                                                          |
| 6. "Shock" index, SI                         | $SI = HR / ADs$                                                                        |
| 7. Shock volume, UO                          | $UO = 100 + 0,5 \times PD - 0,6 \times ADd \times AY$ ,<br>AY - patient's age in years |
| 8. Minute volume of blood, MV                | $MV = UO \times HR$                                                                    |
| 9. Total peripheral vascular resistance, OPS | $OPS = (SDD \times 1332 \times 60) / MV$                                               |
| 10. Average left ventricular function, AL    | $AL = (UO \times SDD \times 13,5) / 1000$                                              |

## Results and Discussion

To conduct a comparative assessment of the quality of the selected methods of local anesthesia, the indicators that most actively change in the dynamics of the treatment and anesthesia were used. The results of the study are presented in Table 2. These data indicate the completeness of significant differences in quali-

ty indicators (efficiency and safety), depending on the methods of local anesthesia used (conductor and intraosseous).

**Table 2.** Comparison of quality indicators of local anesthesia methods

| Indicators of the quality of local anesthesia                                                                                         | Method of local anesthesia <sup>1</sup> .                                        |                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|-------------------------------------------------------------------------|
|                                                                                                                                       | Conductor anesthesia by P. M. Egorov                                             | Intraosseous with the use of the "Anesto RA-5" device»                  |
| 1. Pain when administering an anesthetic solution                                                                                     | Moderate to significant in 100% of patients                                      | Absent (92 %of patients) or insignificant (8% of patients)              |
| 2. The timing of the onset of anesthesia                                                                                              | After 10-15 minutes in 95.0% of patients                                         | Immediately after the injection of the anesthetic (in 100% of patients) |
| 3. The duration of anesthesia                                                                                                         | Within 50-60 minutes                                                             | 30-50 minutes                                                           |
| 4. Insufficient effectiveness of anesthesia, which predetermined the need for repeated administration of the anesthetic drug          | In 5.0% of patients                                                              | Not installed                                                           |
| 5. The preference of the development of methods of anesthesia                                                                         | Requires knowledge of anatomy, technical skills, development time up to 3 months | Up to 1 week                                                            |
| 6. Short-term side effects that occur immediately after anesthesia (paresthesia, sharp numbness)                                      | In 3.0% of patients                                                              | Not installed                                                           |
| 7. Persistent paresthesia, numbness, contracture of the lower jaw with the formation of hematomas that require conservative treatment | In 3.0% of patients In                                                           | Not installed                                                           |
| 8. The manifestation of persistent and pronounced hyperdynamics of the circulatory system                                             | 18.0% of patients                                                                | In 1.0% of patients                                                     |
| 9. Severe hyperdynamics of the circulatory system, the need for phar-                                                                 | In 5.0% of patients                                                              | In 1.6 % of patients                                                    |

| macological correction                                        |                                                        |                                     |
|---------------------------------------------------------------|--------------------------------------------------------|-------------------------------------|
| 10. Assessment of the quality of local anesthesia by patients | Positive - 86.0%<br>Neutral - 9.0%,<br>Negative - 5.0% | Positive - 9.0%,<br>Neutral - 10.0% |
| 11. Assessment of the quality of local anesthesia by doctors  | Positive - 94.0%<br>Neutral - 6.0%                     | Positive - 96.0%<br>Neutral - 4.0%  |

Thus, the most significant differences were found in relation to such indicators as the timing of the onset of anesthesia, the almost complete absence of pain during the administration of an anesthetic solution, short-term and long-term side effects (paresthesia, contractures of the lower jaw, hematomas with long-term treatment), the absence of which is characteristic of intraosseous anesthesia.

The initial indicators (the first stage of the study) reflect the conditions of mild hyperdynamics of the circulatory system, without significant differences in the clinical groups. An increase in systolic blood pressure, heart rate, and a decrease in stroke blood volume were more significant in patients who underwent conduction anesthesia.

By the time of fixing the "moment" of the onset of anesthesia, a more pronounced tendency to equalize such indicators as blood pressure, heart rate, and minute blood volume in patients using intraosseous anesthesia can be noted.

After the completion of dental manipulations, the studied indicators of hemodynamic homeostasis were almost within the limits of possible physiological fluctuations, regardless of the method of local anesthesia used. Thus, the maximum deviations, regardless of the method of anesthesia used in healthy patients, were established at the 2 stage of the study-immediately after the anesthesia was performed.

At the same time, the intensity of deviations of such indicators as the values of systolic blood pressure, heart rate, and stroke volume were more significant precisely when using pro-water anesthesia. After the onset of anesthesia, there was a clear tendency to normalize the studied parameters. Their almost complete normalization was established in healthy individuals by the 4 stage of the studies.

From the presented data, it follows that immediately before local anesthesia in patients with background pathology, signs of hyperdynamics of the circulatory system were determined, manifested by an increase in systolic blood pressure, heart rate.

Against the background of a significant decrease in the value of the shock volume of blood, the minute volume of blood circulation was maintained only against the background of increasing tachycardia. Immediately after the local anesthesia, the hyperdynamic phenomena increased, and they were more pronounced with the use of conductor anesthesia. Studies conducted after the onset of anesthesia in patients with background diseases allowed us to establish some improvements in the studied hemodynamic parameters, and they were more pronounced during intraosseous anesthesia.

When analyzing the data performed by the time of the end of dental manipulations, it was possible to state that the studied parameters of hemodynamics in patients with background pathology significantly improved in comparison with the baseline level (before local anesthesia and dental measures) and were, in general, within the limits of possible physiological fluctuations.

Complex and multifactorial assessment of the quality of methods of local anesthesia in the treatment of chronic pulpitis posterior teeth of the mandible in adult patients to 66 years, who had serious diseases of internal organs, revealed a fairly high level of security and the efficiency of the methods of local anesthesia.

Widely used method of conducting anesthesia, convincingly showed all its positive and negative qualities.

A sufficiently high efficiency and its positive assessment by patients and doctors, however, did not exclude short-term, but also sufficiently pronounced, in some cases, requiring long-term treatment of side effects and complications when using local conductor anesthesia

Complications that required special pharmacological correction due to the increasing level of blood pressure were found in 3% of patients. Their dental treatment was postponed.

At the same time, the use of intraosseous anesthesia using the device "Anesto RA-5" showed that the deviations of the indicators of the blood circulation system, their intensity, were less pronounced in comparison with the indicators obtained by conducting anesthesia. When using intraosseous anesthesia, there are no clinical situations that threaten the health and life of patients, and require additional and emergency pharmacological effects.

To master the method of intraosseous anesthesia using the "Anesto RA-5" device, you need no more than a week, while the development of conducting anesthesia for a dentist-therapist is difficult and requires a long period of time. Dental surgeons, even beginners, master the technique of conducting anesthesia, using it constantly and daily, and dentists-therapists-occasionally. In this regard, the quality of intraosseous anesthesia in therapeutic dentistry in the treatment of chronic pulpitis of the mandibular molars can be evaluated exclusively on the positive side.

## **Conclusion**

Conducting conductor anesthesia according to P. M. Egorov is characterized by a typical psych emotional reaction of the body, reflecting a fairly high level of anxiety, expressed by pain syndrome during and immediately after anesthesia, the occurrence of mainly short-term side effects with a typical hyperdynamic reaction of the circulatory system.

The comparative comprehensive clinical and laboratory analysis, including 20 indicators, convincingly showed a higher level of quality (efficiency and safety) of the method of intraosseous anesthesia with the use of the "Anesto RA-5" device in the treatment of chronic pulpitis of the chewing group of the lower jaw teeth.

The treatment of patients using intraosseous anesthesia and the "Anesto RA-5" device was characterized by a pronounced and fairly rapid decrease in the level of anxiety, minimal pain during the administration of the anesthetic, rapid onset of anesthesia immediately after the administration of the anesthetic, a minimal proportion of short-term side effects, and a relatively rapid normalization of the studied blood circulation indicators

Thus, based on the presented technical and technological characteristics, the available clinical experience in the use of automated devices for intraosseous anesthesia, there is reason to believe that the use of intraosseous anesthesia using the device "Anesto RA-5" is effective and safe in the treatment of pulpitis of the masticatory group of the lower jaw.

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