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Effect of Articaine on Blood Pressure and Heart Rate in Implant Surgery

Cepeda de Romero Beatriz[1]*, Moreno Gómez Javier A[2], Rodríguez L Diana[2] and Romero Fabián Andrés[3]

[1]*Doctor of Medicine and Surgery. Master's Degree in Pharmacological Sciences National University, Associate Professor at UN and UniCIEO. Kr 71 No 127 A 41, Bogotá, Colombia.*

[2]*Dentistry Bosque University. Bogotá, Colombia. Resident of oral and reconstructive implantology Foundation University UniCIEO, Bogotá, Colombia.*

[3]*Dentistry B Rafael Nuñez University Corporation. Bogotá, Colombia. Resident of oral and reconstructive implantology Foundation University UniCIEO, Bogotá, Colombia.*

***Correspondence:**

Cepeda de Romero Beatriz, Doctor of Medicine and Surgery. Master's Degree in Pharmacological Sciences National University, Associate Professor at UN and UniCIEO. Kr 71 No 127 A 41, Bogotá, Colombia.

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ABSTRACT

Local anesthesia is a safe and effective way to control pain during surgical procedures by inhibiting the spread of nerve impulses to the cerebral cortex.

Objective: *To evaluate the effect of articaine 4% with epinephrine 1:100,000 on blood pressure and heart rate: pre anesthesia, post-anesthesia and post-surgery of dental implants.*

Method: *Clinical research with minimal risk, observational, cohort analysis. The sample was 31 patients over 18 years of age, with an informed consent sign, mean age 57.3 ± 12.22 years, 20 women (64.5%) and 11 men (35.5%), healthy (ASA I) or with medically controlled diseases (ASA II), selected for any dental implantology surgical procedure. In a semi-supine position in the dental unit, systolic, diastolic blood pressure (mmHg) and heart rate (c/sec) at the level of the radial artery of the left forearm using a digital blood pressure monitor (SCANMED),® pre surgery, 10 minutes after administration of 4% articaine with 1:100,000 epinephrine, dose of 3.6 milliliters (2 carbines) and post¬ surgery. Statistical analysis using Shapiro Wilk tests, t-test, ANOVA and Pearson correlation.*

Results: *Systolic blood pressure showed a slight increase 10 minutes after local anesthetic and a slight decrease after surgery (122.6 ± 10.4, 126.5 ± 14.1 and 124.5 ± 9.8). Diastolic blood pressure increased gradually and progressively after administration of the local anesthetic and at the end finalize the procedure (75.5 ± 8.3, 77.5 ± 9.4 and 79.6 ± 9.3). The heart rate remained 10 minutes after the application of the anesthetic and decreased slightly at the end of surgery (83.5 ± 9.5, 83.6 ± 8.7 and 81 ± 8.3 c/second), with no statistically significant variations (p>0.05).*

Conclusion: *The use of 4% articaine with 1:100,000 epinephrine does not significantly affect (p>0,05) Heart rat, blood pressure and heart rate values before and after dental implant surgery.*

Keywords

Articaína, Blood pressure, Epinephrine, Heart rate.

Introduction

Pain is an unpleasant sensory and psychological experience that results from actual or potential tissue injury and is commonly associated with dental treatment. Currently an alternative for the replacement of lost dental structures is the placement of dental implants, where the use of local anesthetics is essential. Local anesthesia is a safe and effective way to control pain. They work by reversibly binding to sodium channels in the membrane of all cells, preventing sodium from entering all cells, thereby inhibiting

the propagation of nerve impulses to the cerebral cortex. The nociceptive impulses associated with painful stimuli during the surgical process do not reach the somesthetic cerebral cortex and the patient does not perceive the pain [1]. According to their chemical structure, local anesthetics are classified into esters and amides, which changes their metabolism, potency, efficiency and time of action. Articaine is an amide, so its metabolism takes place in plasma and liver. In the mouth, if the anesthetic is placed infiltratively, there is a loss of sensitivity due to blockage of the sensory receptors at the site of application, and if it is applied truncally, it causes a block of the entire nerve conduction in the corresponding nerve: upper or lower jaw [2]. The clinical advantages of articaine include longer duration of its anesthetic effect, second only to ultra-long-acting anesthetics such as Bupivacaine, Etidocaine, and Ropivacaine, it also diffuses through bone tissue [2].

The high plasma concentration of local anesthetics in the nervous system leads to temporary blockage of inhibitory cortical pathways by blocking sodium channels, which manifests itself with changes in visual and sensory perception, and finally seizures. The progressive increase in the plasma concentration of anesthetics eventually affects the excitatory pathways, leading to a general depression of neurological activity ranging from loss of consciousness to respiratory arrest [2]. In the cardiovascular system, it causes alterations in conduction and cardiac contraction. During the excitatory phase of central nervous system toxicity, tachycardia and hypertension due to sympathetic activation may occur, which can lead to arrhythmias and myocardial dysfunction. Local anesthetics, due to their mechanism of action in all cell membranes, trigger different responses in the body (AMR), at the level of sensory receptors and axons, block sensory and motor perception, in the central nervous system sensory, motor and emotional deficiencies, at the cardiovascular level bradycardia, arrhythmia, negative inotropism, vasodilation, hypotension, cardiovascular collapse and death [2].

The use of anesthetics with vasoconstrictor is justified in dentistry, because it delays the absorption of the anesthetic agent into the bloodstream, which prevents systemic adverse reactions inherent to its mechanism of action, reduces the risk of toxicity and provides hemostasis during the surgical procedure, which also prolongs the therapeutic time of the anesthetic at the administered site [3].

During dental clinical practice, the administration of local anesthetics is necessary to perform dental procedures such as tooth extraction, surgical procedures such as implant placement, flap lifting, sutures and grafts, among others. It is clear that this type of procedure can generate stress and some systemic disorder in medically compromised patients that can significantly compromise the health of patients [4].

Some studies have shown that an increase in blood pressure during dental surgery is common even in normotensive patients. This increase is influenced by many factors, such as psychological and physical stress, painful stimuli, and the action of catecholamines present in local anesthetics [5].

Background

Abu-Mostafa N, et al., [3] investigated changes in blood pressure, heart rate, and oxygen saturation in systemically healthy patients under tooth extraction treatment, using local anesthetics with various concentrations of epinephrine in 120 patients who were divided into 3 groups of 40 people each. Patients in group 1 were given 2% lidocaine with 1:80,000 epinephrine, 4% Articaine patients with 1:100,000 epinephrine, and 4% Articaine patients with 1:200,000 epinephrine in group 3. The results showed that systolic and diastolic blood pressure, oxygen saturation and heart rate did not present statistically significant differences between the three groups, however, 4% articaine with epinephrine concentration 1:200,000 showed fewer changes than 2% lidocaine with epinephrine 1:80,000 in systolic blood pressure, therefore, it could be suggested that Articaine is safer.

Lasemi, et al., [7] In a randomized clinical study, they compared the effects of 4% articaine with 1:100,000 epinephrine and 4% articaine 1:200,000. They evaluated blood pressure (systolic and diastolic) and heart rate, related to the onset and duration of anesthesia. Among the results were changes in systolic blood pressure during and 5 minutes after the application of the anesthetic Articaine 4%, with epinephrine 1:100.00 without statistically significant differences, changes in systolic blood pressure ($p= 0,04$), diastolic blood pressure ($p= 0.08$) and heart rate ($p= 0.06$).

Siddiqui H, et al., [8], evaluated the changes in blood pressure and pulse rate of hypertensive patients before, during, and after extraction under local anesthesia with epinephrine compared to a control group. It shows 75 male and female patients, aged between 25 and 70 years, arranged in three groups. Each group is composed of 25 subjects. Group A: hypertensive patients/lidocaine. Group B: hypertensive/lidocaine patients with epinephrine 1:100,000m. Group C: normotensive/lidocaine patients with epinephrine 1:100,000. The results showed that blood pressure increased in all groups two minutes after administration and was maintained even 5 minutes after extraction returned to baseline values. No clinically and statistically no significant differences changes were observed in blood pressure values, since that the results did not bring any change in hypertensive patients controlled with and without epinephrine. There was no significant change between normotensive and hypertensive patients using anesthetic with epinephrine.

Melo PE, et al., [9] They examined the hemodynamic variations during the extraction of impacted third molars using 2% lidocaine or Articaina 4% as local anesthetics, 14 patients applied for the study, 2 men and 12 women, with a mean age of 22.4 years. There were no significant differences in the hemodynamic behavior of the patients, when 2% lidocaine was compared with 4% Articaine. Systolic blood pressure and Diastolic blood pressure difference in every moment during surgery, comparing articaine and lidocaine $p< 0.05$.

Yamashita K, et al., [10], evaluated the influence of two types of anesthetics lidocaine-epinephrine, prilocaine-Phelipresine, during the extraction of the impacted mandibular third molar in 40 female patients between 20 and 40 years of age. Decreased parasympathetic nerve activity was demonstrated with lidocaine-epinephrine and increased sympathetic nerve activity with Prilocaine-Phelipresin administration.

Furci F, et al., [11] conducted a study in which they took 159 patients to evaluate whether the adverse effects that occurred in local anesthetics, of the 159 people, 125 were female, and 34 male, they concluded that allergy to local anesthetics is rare, however, to prevent unnecessary events, It is important that the health professionals involved are prepared for the appropriate management at the time of suspected allergy.

Moaddabi A, et al. [12]; Evaluation of the effects of Articaine4% with epinephrine 1:100,000, on blood pressure, after the maxillary infiltration technique in 102 male and female patients, with an age range between 18 and 55 years, divided into two groups, one with the use of lidocaine and the other with Articaine. In this study, they demonstrated that systolic and diastolic blood pressures before and after anesthesia placement were not significantly different between groups lidocaine and articaine groups ($p = 0.540$ and $p = 0.471$, respectively) However, the authors reported a statistically different increase in blood pressure from each experimental group. With this, it was concluded that Articaine can be considered a suitable alternative to lidocaine for local maxillary infiltration.

Li J et al., [13], analyzed changes in heart rate and blood pressure when performing a tooth extraction in adult patients of both sexes with the presence of systemic diseases, which are considered risk factors when using local anesthetics. The author analyzed 3,044 elderly outpatients. They found an increase in heart rate, systolic blood pressure and diastolic blood pressure in elderly patients and patients with systemic diseases such as diabetes.

George A et al., [14] compared hemodynamic changes in blood pressure, heart rate, and oxygen saturation in normotensive (50 patients) and hypertensive (50 patients) patients before and during tooth extraction. With a total of 100 patients between 40-70 years old; They found no statistically significant differences in blood pressure and heart rate values related to age and sex of the different study groups.

Importance and Justification

The analysis and recording of the different cardiovascular effects that may occur in patients undergoing dental implant therapy is of vital importance for the planning and care of dental treatments. Local anesthetics are commonly used in clinical practice for their intraoperative benefits, in the same way allergic reactions and vasovagal adverse reactions are known: hypotension us bradycardia and hemodynamic changes; which can alter the normal development of clinical procedures, in this way there is the need to analyze hemodynamic changes before anesthesia and after anesthesia (10 minutes after administration of the local anesthetic and at the end of dental implant surgery [10,11]. This last measurement is of vital importance to evaluate, since it allows the collection of data related to the uncontrolled variables, which could influence in a certain way the two variables to be evaluated (blood pressure and heart rate). This information may be taken into account in the future for the design and implementation of new studies related to these variables.

It has been shown that older adults are the ones who most need dental implants and variations in blood pressure and heart rate are more frequent. Therefore, it is necessary for the health professional to monitor the patient's vital signs and general condition during the clinical procedure [12]. Monitoring the patient's hemodynamic changes will allow the professional to have adequate control of the clinical situation and safety during the procedure, avoiding this forms the presence of emergency events that put the patient's life at risk [13,14].

Objective

To evaluate the effect of Articaine 4% with epinephrine 1:100,000, with a dose of 3.6 milliliters (2 carbines) on blood pressure and heart rate values in three surgical times: pre-anesthesia, 10 minutes post-anesthesia and at the end of the surgical procedure, using a digital blood pressure monitor (SCANMED)®.

Method

Clinical, observational, analytical longitudinal cohort research. With approval by the Institutional Ethics Committee as a minimum risk research (Annex 1). Sample: Patients who were selected for any oral implantology surgical procedure placement of dental implants, who voluntarily wished to participate in the study, explanation and signing of the informed consent for this research (Annex 3), during the period between August 2023 and January 26, 2024, who were operated on with any surgical procedure for the placement of dental implants and the use of Articaine4% with epinephrine 1:100,000. Over 18 years of age, healthy men and women (ASA I) or with the presence of diseases controlled by their treating physician (ASA II) and the certification of the treating physician indicating that they are suitable to have the procedure performed with dental implants. Patients were placed in a semi-supine position in the dental unit for the assessment of systolic and diastolic blood pressure and heart rate at the level of the radial artery of the left forearm using a digital blood pressure monitor (SCANMED)®, in three stages: pre-anesthesia, 10 minutes post-anesthesia and at the end of the surgical procedure: guided or conventional surgery, type of implant, Implant size that can vary from 12 mm to 6 mm in length and from 3 mm to 6 mm in diameter. Surgical time was assessed in hours, changes in systolic and diastolic blood pressure in millimeters of mercury (mmHg) and heart rate in cycles per second (c/sec) with a digital blood pressure monitor (SCANMED)®.

Descriptive statistics (means and medians) and inferential statistics were applied to all these variables by means of a paired t-test,

then a multivariate test (before and after) was performed. The different sociodemographic variables to be studied are recorded in the information collection instrument (Annex 3), which will be analyzed according to the established statistical parameters. Statistical analysis: or the present research; Initially, descriptive analysis, mean and standard deviation were used for quantitative variables, and absolute frequency and relative frequency were used for categorical or qualitative variables. Subsequently, for the comparison of heart rate and blood pressure in the three assessment times, the repeated measures ANOVA test and the Bonferroni Post-Hoc test were used. The t-test was used to compare heart rate and systolic and diastolic blood pressure in each of its 3 times with respect to the main demographic, clinical and procedural variables. Previously, the Shapiro Wilk test was performed in order to check the distribution of quantitative data, which established the use of parametric tests for the different comparisons. Finally, Pearson's correlation was used to establish the degree of dependence of heart rate, systolic pressure and diastolic pressure with respect to age, number of implants and surgical time. All tests were conducted with a 95% confidence level. The processing was carried out using the SPSS version 24 program.

Results

Total sample, 31 patients who met the inclusion criteria, with mean age (SD) 57.3 ± 12,220 years, 20 women (64.5%), 11 men (35.5%). Healthy patients without systemic ASA I involvement (83.9%), with medically controlled ASA II systemic involvement (16.1%). The most frequent disease was arterial hypertension (12.9%), followed by hypothyroidism (9.7%) and finally chronic obstructive pulmonary disease (COPD) (3.2%). Medicated patients (16.1%). Arterial hypertension medicated with Enalapril (20.0%), Losartan (40.0%), Verapamil (20.0%). Hypothyroidism medicated with levothyroxine (20.0%). Alcohol and Psychotropics Drugs (3.2%). Intolerance to drugs (penicillin) (3.2%).

The most commonly used surgical procedure was the placement of dental implants (80.6%) and the most commonly used type of implant was that of the commercial firm BioHorizons® (80.6%). Some patients required pre-implant surgical procedures such as maxillary sinus grafting or guided bone regeneration (19.4%). The heart rate values in the total sample at the three times evaluated did not show significant differences (p= 0.140), performed by means of the ANOVA test of repeated measures with Bonferroni's Post-Hoc test. (Table 1), Figure 1).

Table 1: Comparison of heart rate and blood pressure during implant surgery.

	Pre-surgical	10 min (post-articaine)	Post-surgical	P value
Heart rate	83.5 ± 9.5	83.6 ± 8.7	81 ± 8.3	0.140
Systólic blood pressure	122.6 ± 10.4	126.5 ± 14.1	124.5 ± 9.8	0.293
Diastólic blood pressure	75.5 ± 8.3	77.5 ± 9.4	79.6 ± 9.3	0.193

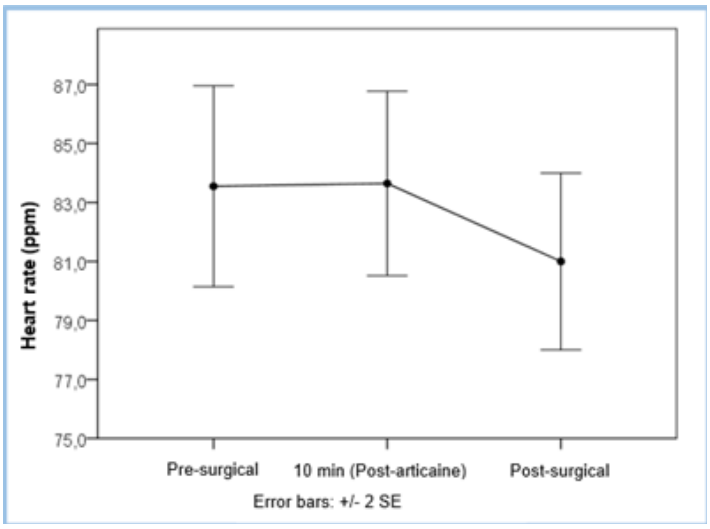

Figure 1: Heart rate in the three surgical times evaluated.

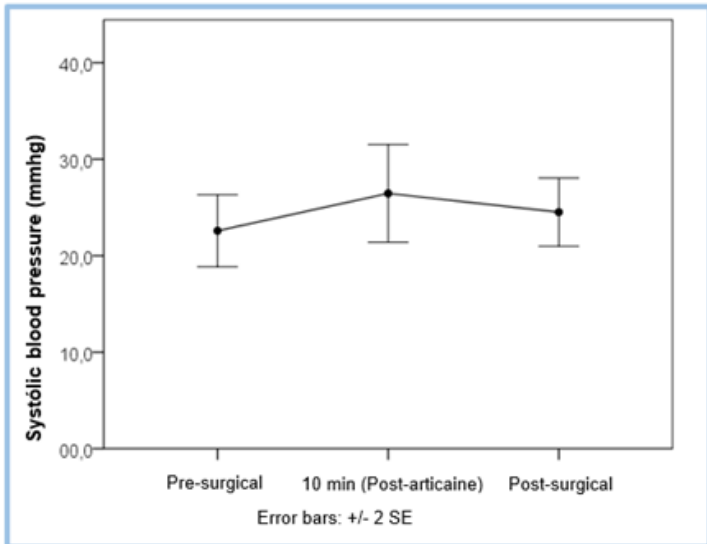

Figure 2: Systolic blood pressure in the three surgical times evaluated.

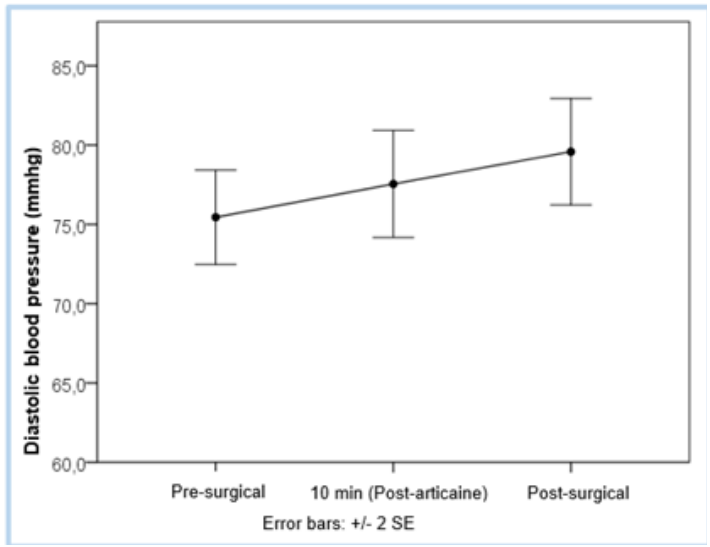

Figure 3: Diastolic blood pressure in the three surgical times evaluated (t-test).

The comparison of diastolic blood pressure values in the three times evaluated: pre-surgical, 10 minutes after the administration of articaine and post-surgical with the main sociodemographic variables, showed that there was only a significant difference (p=0.023) in diastolic blood pressure values between hypertensive and normotensive patients (p=0.023) performed by t-test.

The correlation analysis between the age of the patients, the number of implants placed per procedure and the surgical time with variations in heart rate and blood pressure using the Pearson statistical test showed that there is a significant difference (P= 0.048).

Discussion

In the present study, patients undergoing different surgical techniques of dental implantology and use of Articaína with Epinephrine with or without bone regeneration, heart rate and pressure values arterial pre-anesthesia, 10 minutes post-anesthesia and post-surgery, they did not present significant differences and are within the normal ranges. This coincides with the study by Abu-Mostafa N, et al., [3] where the results showed that patients with molar extraction, systolic and diastolic blood pressure, oxygen saturation and heart rate did not present statistically significant differences between the groups managed with articaine. It also coincides with the similar but not equal study by Moaddabi A, et al. [12]., where it was shown that the use of articaine or lidocaine did not present significant differences in the values of systolic and diastolic blood pressures, before and after the placement of anesthesia. This suggests, as does the present research, that the use of the local anesthetic Articaine 4% with epinephrine 1:100,000 did not show statistically significant alterations in heart rate and blood pressure.

In the present study, the correlation analysis between age, sex, systemic diseases and number of implants placed in the surgical act did not present significant differences with respect to heart rate values and systolic and diastolic blood pressure. Possibly because the elderly patients were in good health and some had high blood pressure controlled by their treating physician with antihypertensives and diuretics. This differs from the study de Li J, et al., [13], where they analyzed the changes in heart rate and blood pressure at the time of dental extraction in patients of legal age, of different sex and with the presence of systemic diseases such as diabetes that are considered risk factors when using local anesthetics, which is why there were increases in the physiological constants of heart rate and blood pressure after the application of articaine with epinephrine.

In the present research, no significant statistical and clinical changes were observed in blood pressure and heart rate values between normotensive and hypertensive patients, probably due to the fact that hypertensive patients were kept medically controlled by their treating physician with antihypertensives. These results coincide with the study by Siddiqui H, et al., from 2017 [8], in which they evaluated changes in blood pressure and pulse rate in hypertensive and normotensive patients.

In the present study, no significant differences were established in changes in heart rate, systolic and diastolic blood pressure related to the age and sex of the patients. This coincides with the study by George A, et al., in [14], where they compared hemodynamic changes in blood pressure, heart rate, and oxygen saturation, where they also found no statistically significant differences in the values related to age and sex of the different study groups.

Conclusion

The use of 4% articaine with 1:100,000 epinephrine does not significantly affect blood pressure and heart rate values before and after dental implant surgery.

References

1. Mathison M, Pepper T. Local Anesthesia Techniques in Dentistry and Oral Surgery. Stat Pearls. 2022.
2. Arumugam S, Contino V, Kolli S. Local Anesthetic Systemic Toxicity (LAST) – a Review and Update. Curr Anesthesiol Rep. 2020; 10: 218-226.
3. Abu Mostafa N, Al Showaikhat F, Al Shubbar F, et al. Hemodynamic changes following injection of local anesthetics with different concentrations of epinephrine during simple tooth extraction: A prospective randomized clinical trial. J Clin Exp Dent. 2015; 7: 471-474.
4. Colson P, Gaudard P. Hypertension and Management Hypertension and Anesthesia: What's New? J Hypertens Manag. 2016; 2: 1-5.
5. Gadve VR, Shenoi R, Vats V, et al. Evaluation of anxiety, pain, and hemodynamic changes during surgical removal of lower third molar under local anesthesia. Ann Maxillofac Surg. 2018; 8: 247-253.
6. Massignan C, Silveira Santos P, Cardoso M, et al. Efficacy and adverse events of 4% articaine compared with 2% lidocaine on primary molar extraction: A randomised controlled trial. J Oral Rehabil. 2020; 47: 1031-1040.
7. Lasemi E, Sezavar M, Habibi L, et al. Articaine (4%) with epinephrine (1:100,000 or 1:200,000) in inferior alveolar nerve block: Effects on the vital signs and onset, and duration of anesthesia. J Dent Anesth Pain Med. 2015; 15: 201-205.
8. Siddiqui H, Hussain A, Khan FNA, et al. Systemic Effects of Local Anaesthesia in Hypertensive Patients. Pak Oral Dent J. 2017; 37: 538-542.
9. Melo PE, Saulo S, Moreira G, et al. Hemodynamic Behavior in Third Molar Surgeries Using Lidocaine or Articaine Comportamiento Hemodinámico en Cirugías de los Terceros Molares Utilizando Lidocaína vs Articaina. Int J Odonto. 2018; 12: 76.
10. Yamashita K, Kibe T, Shidou R, et al. Difference in the Effects of Lidocaine With Epinephrine and Prilocaine With Felypressin on the Autonomic Nervous System During Extraction of the Impacted Mandibular Third Molar: A Randomized Controlled Trial. J Oral Maxillofac Surg. 2020; 78: 215.

11. Furci F, Martina S, Faccioni P, et al. Adverse reaction to local anaesthetics: Is it always allergy?. Oral Dis. 2020; 26: 1340-1342.

12. Moaddabi A, Soltani P, Zamanzadeh M, et al. Comparison of the Effects of Articaine and Lidocaine Anesthetics on Blood Pressure after Maxillary Infiltration Technique: A Triple-Blind Randomized Clinical Trial. Int J Dent. 2021; 2021: 8894160.

13. Li J, Tian Z, Qi S, et al. Cardiovascular Response of Aged Outpatients With Systemic Diseases During Tooth Extraction: A Single-Center Retrospective Observational Study. Front Public Heal. 2022; 19: 10.

14. George A, Sharma M, Kumar P, et al. Hemodynamic changes during exodontia in hypertensive and normotensive patients following injection of local anesthetics with and without epinephrine: A prospective comparative study. Rev Esp Cir Oral Maxilofac. 2022; 44: 9-15.