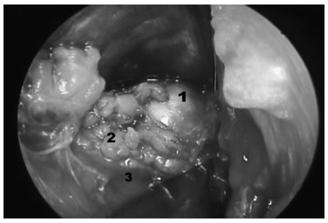

FIGURE 5. After displacement of anatomic elements, the following elements appear widely exposed: (1) the tumor, (2) the parotid gland, and (3) the masseter muscle.

achieved. The use of transoral area is the most feasible approach of NOS.[5]

The parotid gland has a shaped roughly like an inverted pyramid, with 3 (or 4) sides. It has a base (from which the superficial temporal vessels and auriculotemporal nerve emerge), an apex (which descends inferior and posterior to the angle of the mandible), and lateral, anterior, and posterior surfaces. The anterior border is on the masseter muscle, producing a medial lip under cover of which the parotid ducts and the branches of the facial nerve emerge.

The parotid gland can have an anterior portion, which can be isolated or connected with the central body of the gland or forming an accessory glandular functionally independent and draining directly into the Stensen duct; benign or malignant tumors can arise in the anterior parotid glandular portion.

Tumors of this area of the parotid gland, minor salivary glands, and the masseter muscle are current pathologic conditions that can be successfully treated by endoscopic surgery. Tumors of minor salivary glands can be classically removed, but video-assisted technique offers both good illumination and excellent magnification, permitting a more easily surgical maneuvers. The surgery of a tumor of either the anterior portion of the parotid gland or the masseter muscle has traditionally been a challenge for head and neck surgeons for many reasons. The principal difficulty is the reduced operative field when a classic intraoral approach is performed. On the other hand, if a classic preauricular approach is used, the surgical field is far from initial incision; the anatomic elements, principally branches of the facial nerve and the Stensen duct, can be easily injured during tumor resection.

A good illumination and magnification supported by endoscopic surgery providing clear and sharply vision, permitting not only a safe anatomic dissection but also surgical maneuvers in avascular planes, contributed to avoid injuries of facial nerve branches and secondary obstruction of the Stensen duct.

Before surgery, the canalization of the Stensen duct can be made, offering better individualization and recognizance of such anatomic element.

In all 16 patients, minimal or no pain was reported, and analgesic drugs were only necessary in the first postoperative hours; any kind of discomfort was claimed by patients. Three complications (18%) were detected in all 16 patients operated on with this technique: 2 hematomas in masseter tumor resection and 1 paresis of the superior buccal nerve with spontaneous recuperation 3 months later.

Soft and lax tissue of the head and neck is ideal for application of endoscopic principles; its anatomic areas can transform in an expandable cavity with avascular planes of dissection.

As a conclusion, the outcome achieved with endoscopic techniques in other surgical areas has permitted to consider it as the first election in the surgical treatment in tumors of the soft tissues of the cheek, offering more advantages than the classic approaches.

The advantages of endoscopic resection are as follows:

1. Better visualization and magnified view of the dissection areas: as a consequence, injury of important anatomic landmark, nerves, and vessel can be avoided.
2. Both hidden (intraoral) and inconspicuous (preauricular) scars are obtained.
3. There is excellent postoperative comfort.
4. There is short hospital stay.

The disadvantages are as follows:

1. It is necessary to have an endoscope and special instruments.
2. Specific surgical training must be made by surgeons.

With the arrival of new surgical techniques, surgeon experience, and advanced endoscopic instruments, the video-assisted surgery can be a safe method of choice in the treatment of several diseases of the head and neck region using natural orifice approaches.

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Hemodynamic Changes Comparing 2% Lidocaine and 4% Articaine With Epinephrine 1:100,000 in Lower Third Molar Surgery

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Background: An increase in blood pressure during dental treatment has been investigated with regard to potential medical risks since previous studies suggest that dental procedures may cause stress to the patient and, consequently, the cardiovascular system. The aim of the present study was to analyze hemodynamic changes following the administration of either 2% lidocaine (L100) or 4% articaine (A100) (both with epinephrine 1:100,000) in the surgical removal of symmetrically positioned lower third molars.

Methods: A prospective, randomized, double-blind, clinical trial was carried out involving 47 patients. Each patient underwent 1 surgery at each of 2 appointments—one under local anesthesia with L100 and the other with A100. The following parameters were assessed at 4 different times: systolic, diastolic, and mean blood pressure; heart rate; oxygen saturation; rate pressure product; and pressure rate quotient.

Results: No hypertensive peak was observed in systolic, diastolic, and mean blood pressure at any evaluation time. Moreover, the type of anesthetic solution did not affect diastolic blood pressure, heart rate, or oxygen saturation during the surgeries. The pressure rate quotient was the only parameter to exhibit statistically significant differences between groups at different evaluation times ($P < 0.05$).

Conclusions: The hemodynamic parameters evaluated in third molar surgery with 2% lidocaine and 4% articaine (both with epinephrine 1:100,000) did not show significant differences.

Key Words: Third molar, tooth extraction, cardiovascular diseases, anesthetics, local, epinephrine, lidocaine

The local anesthetics most often used in dental practice include lidocaine, articaine, mepivacaine, and prilocaine. These drugs are normally used in combination with a vasoconstrictor to slow down the systemic absorption of the anesthetic, thereby prolonging its action and the intensity of block.[1] The use of a vasoconstrictor also increases safety, as lower doses of anesthetic are needed, which lessens toxicity. Moreover, a certain degree of ischemia is maintained, which facilitates hemostatic action and lessens bleeding.[2]

An increase in blood pressure during dental treatment has been investigated with regard to potential medical risks.[1–28] Earlier studies suggest that dental procedures may cause stress to the patient and, consequently, the cardiovascular system.[9,16,20,23,26,27] Pain during dental treatment can trigger the release of endogenous catecholamine, which, in turn, gives rise to hemodynamic changes, such as an increase in blood pressure and heart rate and may even produce arrhythmia.[1] A significant increase (5–12 mm Hg) in systolic blood pressure has been reported in patients subjected to root scaling and planing using anesthesia with a vasoconstrictor.[14] Sung et al[25] report that the administration of progressive doses of epinephrine at concentrations lower than those used in dental practice gives rise to an increase in cardiac output and oxygen consumption.

Lidocaine is the most widely used local anesthetic for controlling pain, as its pharmacokinetic characteristics and low toxicity in comparison to ester-type anesthetics make it safe for use in dental practice.[6] Articaine was first synthesized by Rusching et al in 1969 under the name carticaine and was first marketed in Germany[29] in 1976 and include the substitution of the aromatic ring with a thiophenic ring.[30]

The amount of administered epinephrine that reaches the general circulation after local anesthesia for dentistry has been hypothesized to be less than the amount of epinephrine endogenously released in response to the pain and stress of inadequate anesthesia.[31] Psychogenic stress may also play a role in the release of endogenous catecholamines. In physiologic response to stimulation and stress, the increase in plasma epinephrine is accompanied by a comparable increase in plasma norepinephrine concentration. By measuring concomitant plasma norepinephrine levels in 3 studies[32–34] and by using lidocaine without epinephrine as a control in another,[35] it was determined that this hypothesis is without support. Thus, the significant change in epinephrine concentration probably originated from exogenous epinephrine rather than the stress response.[36] High anxiety, younger age, and traumatic dental history were correlated with greater increases in heart rate during the administration of local dental anesthesia.[37] In addition, systemic investigations of the emotional sphere, central hemodynamic and autonomic regulation of cardiac rhythm enable assessment of severity of psychological influence in hemodynamic parameters.[38]

It has recently been shown that a 4% articaine solution with adrenaline 1:200,000 provides a comparable degree of pulp anesthesia to 4% articaine with adrenaline 1:100,000.[39] Although most information on the cardiovascular response to dental local anesthesia with articaine is limited to healthy patients,[10,13,19,40] these data may still be of value to cardiologists, primary care physicians, surgeons, and dentists regarding the selection of a preferred local anesthetic for patients with cardiovascular conditions. On the other hand, no significant hemodynamic changes in patients with controlled hypertension have been attributed to 4% articaine with adrenaline 1:200,000 when fewer than 3 local anesthetic carpules are administered.[1,7] Few studies[17,19] have compared 2% lidocaine and 4% articaine with adrenaline 1:100,000, particularly in terms of hemodynamic changes.

The experimental model of the bilateral surgical removal of impacted lower third molars was used for evaluation of the anesthetic agents in hemodynamic parameters; however, few studies[17,19] have compared 2% lidocaine and 4% articaine with adrenaline 1:100,000, particularly in terms of hemodynamic changes with the split-mouth design, which reduced bias for the comparison of the results.[41] Thus, the present study was undertaken to assess hemodynamic changes following the administration of either 2% lidocaine or 4% articaine (both with epinephrine 1:100,000) in the surgical removal of symmetrically positioned lower third molars.

METHODS

The protocol of the present study received approval from the institutional ethics committee (CEP/UPE: 001.0.097.000-08). The subjects were selected from a pool of patients admitted for regular dental treatment between January 2009 and December 2010. All participants signed a term of informed consent that includes the paresthesia risk, especially since the procedures required and included mandibular block anesthesia.

A prospective, randomized, double-blind, clinical trial was carried out. The split-mouth design was used, with the mandibular right and left quadrants of the mouth constituting the experimental units and randomly assigned to 2 treatment groups. The fact that each patient served as his/her own control (crossover design) enhanced the statistical power of the study.[41,42]

The sample size was estimated using the PC-Size program (version 1.01), with data for independent samples used for comparison purposes. The difference in heart rate reported for different evaluation periods in the study carried out by Frabetti et al[8] was used as the parameter, as the results proved statistically significant ($P < 0.05$). With an α value of 5% and a β value of 80%, it was determined that 42 patients would be needed for the study.

Forty-seven healthy, nonsmoking patients (33 men and 11 women aged 18–31 years; mean age, 23.38 [SD, 5.61] years) scheduled for the surgical removal of bilateral, symmetrically positioned, impacted mandibular third molars were enrolled in the study. All third molars were indicated for removal by orthodontic reasons. The subjects had no known immune impairment and no contraindications for oral surgery and were not taking any medication. The eligibility criteria included absence of systemic illness and no signs of inflammation or infection at the extraction sites. Exclusion criteria included a medical history of cardiovascular or kidney disease, gastrointestinal bleeding or ulceration, allergic reaction to local anesthetic, allergy to aspirin, ibuprofen or any similar drugs, and pregnancy or current lactation. Patients were also given instructions not to take any other pain medication before the removal of the third molars. Orthopantomographic radiograms were taken to ensure the similarity of the tooth inclinations based on Winter classification[43] and the Pell and Gregory classification.[44]

A patient's anxiety was assessed using a reliable and validated questionnaire, the Modified Dental Anxiety Scale (MDAS) that was completed by the patient.[45] The MDAS is composed of 5 questions, each of which has 5 alternative answers, ranging from 1 (no anxiety) to 5 (extreme anxiety). Upon answering all 5 questions, the lowest score possible is 5, which would correspond to no anxiety, and the highest score possible is 25, which would correspond to extreme anxiety. A previous work has established that subjects with MDAS scores of 16 or greater are dentally anxious, whereas those with scores higher than 19 are considered dentally phobic.[46] In the present study, only individuals with scores from 1 to 15 were included.

The randomization process was carried out based on items 8 to 10 of the CONSORT statement 2001 checklist for randomized controlled clinical trials (Cochrane Collaboration, Manchester, UK).[47] Allocation to the 2 groups was performed by selecting from a set of sequentially numbered, opaque, sealed envelopes containing either of the 2 interventions—2% lidocaine with 1:100,000 epinephrine (L100) or 4% articaine with 1:100,000 epinephrine (A100). Each impacted lower third molar (right and left sides) had an equal chance of being assigned to 1 of the 2 groups. The randomization process also determined which side would undergo the first surgery and which would undergo the second surgery. During the entire double-blind study, randomization was conducted by the same researcher with ample research experience.

The preoperative treatment protocol for all patients included prescription of 8 mg of dexamethasone and 1 g of amoxicillin taken orally 1 hour before surgery. The surgeon ensured that all patients knew how to take the prescribed medication.

Dental extraction was carried out in a relaxed atmosphere, with no anxiolytic premedication. On the day of the extraction, the patients had a light breakfast and were instructed to take their usual medication at that time. The consumption of alcohol or coffee was to be avoided beginning the night before.

Each patient was operated on by the same senior oral maxillofacial surgeon, using the same surgical technique on both sides to minimize discrepancies in the handling of the tissues. Extraoral antisepsis was performed with a 2.0% chlorhexidine solution, and intraoral antisepsis was performed with a 0.12% chlorhexidine rinse. The patient then received the inferior alveolar nerve block and buccal nerve block to anesthetize buccal, lingual, and inferior alveolar nerves with 1.8 mL of the anesthetic solution. After 5 minutes, 0.9 mL of the same anesthetic was injected into the mucosa to ensure hemostasis and anesthesia of the site. An additional amount of anesthetic solution was injected when the patient complained of pain during the surgery; however, such patients were excluded from the sample. The materials and instruments routinely required for this type of surgery were used, and the standardized technique was performed. Briefly, an L-shaped incision was made, and a mucoperiosteal flap was raised. When osteotomy and tooth sectioning were performed on one side, the other side received the same treatment to standardize the surgical trauma. All procedures were performed under abundant irrigation with sterilized 0.9% physiological solution. The closure of the mucoperiosteal flap was performed with 3-0 silk. The duration of the surgical procedure was counted from incision until tooth removal. Surgical procedures exceeding 30 minutes were excluded from the analysis. Moreover, when one side exceeded the other side by more than 10 minutes, the patient was excluded. One impacted lower third molar was removed on the first surgical visit, and the contralateral lower third molar was removed on the second surgical visit, which was scheduled for 3 weeks later.

In the first 48 hours after surgery, the patients were authorized to take analgesics (acetaminophen 750 mg 4 times daily) only in case of pain. Acetaminophen was also used as the rescue drug. The patients were instructed to eat only soft food and abstain from mouth washing for the first 24 hours and from brushing and flossing around the surgical area until the removal of the suture (14 days after surgery). For plaque control, the patients used a 0.12% chlorhexidine mouth rinse for 1 minute twice a day for 2 weeks postoperatively.

Systolic, diastolic, and mean blood pressure; heart rate; and oxygen saturation (Spo_2) were assessed before (T0) and during the surgery (T1 and T2) as well as after suturing (T3). Two measurements were made during surgery—one immediately after the regional anesthetic block (T1) and another 5 minutes later (T2). Oxygen saturation is defined as the ratio of oxygen bound to hemoglobin of the total concentration of hemoglobin present in the blood. The rate pressure product (RPP) and pressure rate quotient (PRQ) were also evaluated. The RPP is derived by multiplying systolic blood pressure and heart rate and is a good indicator of oxygen consumption by the myocardium in nonanesthetized patients. The PRQ is calculated by dividing mean blood pressure by heart rate, and it is used as an indicator of cardiac ischemia. Only few studies evaluated RPP and PRQ.[3,13,17] All the measurements were automated, noninvasive, and performed with the aid of equipment for monitoring hemodynamic parameters (OX-P10 Monitoring System; EMAI, São Paulo, Brazil).

A data bank was generated and analyzed using the Statistical Package for the Social Sciences (SPSS version 13; SPSS Inc, Chicago, IL). Descriptive (measures of central tendency and dispersion) and inferential (with a 5% level of significance) statistics were performed. The Kolmogorov-Smirnov test was used to determine normal or heterogeneous distribution of the data, and appropriate parametric or nonparametric tests were then used. The parametric test was the paired-sample *t* test.

RESULTS

The demographic and baseline characteristics of the sample are summarized in Table 1. Table 2 shows hemodynamic characteristics before the local anesthetic administration. A total of 50 individuals participated in the survey. However, 3 were excluded from the sample—one had additional amount of anesthetic solution injected, and the surgical time exceeded 30 minutes for 2 patients. Thus, 47 participants remained, with 47 impacted lower third molars allocated to the L100 group, and the 47 contralateral impacted lower third molars allocated to the A100 group. The split-mouth design allowed the standardization of the surgical technique, as each patient participated in both groups.

The mean duration of surgery from the time of administration of lidocaine until the completion of the suturing of the surgical wound was 14.91 ± 2.18 minutes, which was not statistically different from that observed after articaine administration (14.67 ± 1.96 minutes) ($P > 0.05$).

No adverse reactions due to the use of either anesthetic solution were observed by the surgeon or reported by the patients during the surgery or the first postoperative hour. Moreover, the patients reported no reactions in the period from the end of the surgery to the removal of the suture.

TABLE 1. Demographic Characteristics at Screening Examination

Variable	Value
No. subjects (both surgical procedures completed)	47
Age, y	
Mean (SD)	23.38 (5.61)
Range	18 to 31
Sex	
No. male/female patients	33/11
Weight, lb	
Mean (SD)	59.83 (14.37)
Range	41–109
Vital signs at screening appointment, mean (SD)	
Heart rate, beats/min	82.53 (11.32)
Systolic blood pressure, mm Hg	121.91 (9.24)
Diastolic blood pressure, mm Hg	80.42 (6.24)
Spo_2	97.40 (1.53)
RPP	10163.40 (1736.87)
PRQ	1.16 (0.16)

Regarding hemodynamic parameters, no hypertensive peak was observed in the measurement of systolic, diastolic, or mean blood pressure at any evaluation time. Moreover, the type of local anesthetic with vasoconstrictor did not affect diastolic or systolic blood pressure ($P > 0.05$; Figs. 1 and 2) during surgery. In both groups, heart rate varied during the surgical procedures, rising after the administration of the local anesthetic solution and returning near to basal levels after suturing; however, this variation did not achieve statistical significance ($P > 0.05$; Fig. 3). A peak increase in Spo_2 occurred immediately after the administration of both local anesthetic solutions, which was maintained until the end of surgery. The type of local anesthetic with vasoconstrictor had no influence over the oximetry results ($P > 0.05$; Fig. 4). Rate pressure product underwent an increase from T1 to T3 with both solutions, but this difference did not achieve statistical significance ($P > 0.05$; Fig. 5). Pressure rate quotient was at the same level in both groups at T0, and there was a decrease in values through to T3, with statistically significant differences between drugs at T1, T2, and T3 ($P < 0.05$; Fig. 6).

DISCUSSION

To investigate the therapeutic efficacy of an anesthetic drug, every effort should be made to standardize the procedure. A crossover study design is useful in eliminating variations in inflammatory response stemming from individual differences. The surgical technique and the surgeon should be the same in all procedures, and the

TABLE 2. Hemodynamic Characteristics Before the Local Anesthetic Administration

	Value	
Variable	L100	A100
Heart rate, beats/min	82.73 (10.43)	82.68 (10.61)
Systolic blood pressure, mm Hg	121.19 (8.34)	121.21 (8.24)
Diastolic blood pressure, mm Hg	80.48 (6.84)	80.12 (6.67)
Spo_2	95.83 (1.44)	95.84 (1.33)
RPP	10069.40 (1865.68)	10154.70 (1785.32)
PRQ	1.16 (0.15)	1.16 (0.15)

Values are presented as mean (SD).

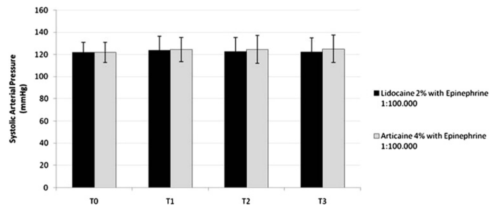

FIGURE 1. Mean systolic blood pressure (in mm Hg) in patients under 2% lidocaine and 4% articaine—both with epinephrine 1:100.000—at 4 different evaluation times; bars demonstrate SD (+/−) in each group. Measurement periods: immediate preoperative (T0), immediately after the regional anesthetic block (T1), 5 minutes later (T2), and after suturing (T3).

patients should be meticulously selected to ensure the similarity of the trauma caused in both surgeries. Thus, the experimental model of the bilateral surgical removal of impacted lower third molars was used for evaluation of the anesthetic agents in the present study.[48] However, most studies[1,4,7,16,18,20,21,23,24,26–29,32,39,40,49] addressing the effects of anesthetic solutions in third molar surgery are performed without the split-mouth design, which hinders the comparison of the results.

No adverse reactions were observed by the surgeon or reported by the patients with either local anesthetic solution even that a 4% solution (A100) has approximately twice as many milligrams per carpule compared with 2% solutions (L100). However, some authors report adverse events after the use of articaine with epinephrine, such as headache, edema of lips, face and eyelids, trismus, soreness, swelling, and paresthesia.[30,50–52] On the other hand, recent articles clearly indicate a higher risk of neurosensory disturbance associated with articaine 4% (and prilocaine 4%), especially in mandibular block anesthesia, than with other drugs in current use.[53–57] It follows that medicines, including local anesthetics, should be used in the least dose and concentration that is effective.

In a comparison of blood pressure values during dental checkups and dental treatment, Ship[23] found a mean systolic difference of 8 mm Hg and mean diastolic difference of 1 mm Hg in oral surgery. Moreover, the author found a systolic pressure change of 4 mm Hg and a diastolic change of 3 mm Hg with operative dentistry, whereas polishing restorations were associated with a systolic pressure change of 1 mm Hg and diastolic change of 2 mm Hg. In contrast, changes in blood pressure in the present study were minimal (<1 mm Hg for both systolic and diastolic pressure).

Many hemodynamic studies have been carried out with patients subjected to local anesthetic injection with a vasoconstrictor.[1–5,7–10,12–15,17–23,28] Some involve subjects with no history of disease and no significant changes recorded in either blood pressure (systolic and diastolic) or heart rate. However, some authors suggest that such changes are dependent on the dose of the injected vasoconstrictor.[58] It is therefore clear that important variations are to be expected if the injection technique is not performed carefully, and the solution is accidentally injected into a blood vessel.[59]

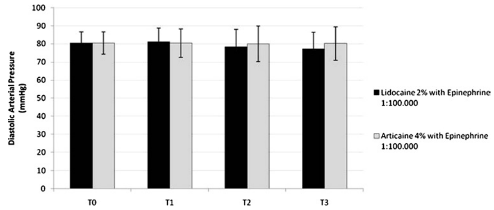

FIGURE 2. Mean diastolic blood pressure (in mm Hg) in patients under 2% lidocaine and 4% articaine—both with epinephrine 1:100.000—at 4 different evaluation times; bars demonstrate SD (+/−) in each group. Measurement periods: immediate preoperative (T0), immediately after the regional anesthetic block (T1), 5 minutes later (T2), and after suturing (T3).

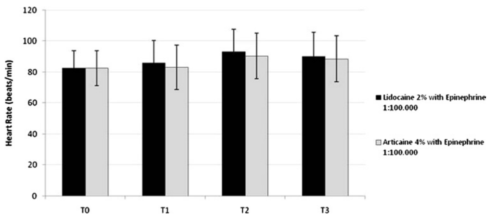

FIGURE 3. Mean heart rate (in beats/min) in patients under 2% lidocaine and 4% articaine—both with epinephrine 1:100.000—at 4 different evaluation times; bars demonstrate SD (+/−) in each group. Measurement periods: immediate preoperative (T0), immediately after the regional anesthetic block (T1), 5 minutes later (T2), and after suturing (T3).

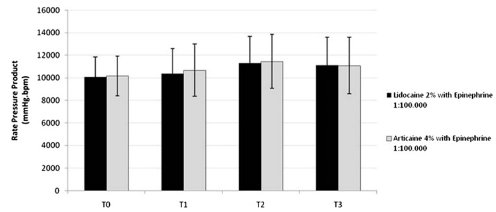

FIGURE 5. Mean RPP (in mm Hg · beats/min) in patients under 2% lidocaine and 4% articaine—both with epinephrine 1:100.000—at 4 different evaluation times; bars demonstrate SD (+/−) in each group. Measurement periods: immediate preoperative (T0), immediately after the regional anesthetic block (T1), 5 minutes later (T2), and after suturing (T3). Rate pressure product is derived by multiplying systolic blood pressure and heart rate.

Dionne et al[32] found that, after the administration of 5.4 mL of 2% lidocaine with epinephrine 1:100,000, taking care to avoid intravascular injection, heart rate increased in 19% of cases, and cardiac output increased as much as 30%. Silvestre et al[1] published 2 previous works; one was carried out in hypertensive patients divided in 2 groups for using articaine with 4% 1:200,000 epinephrine and 3% mepivacaine without vasoconstrictor and another where 43 healthy males with normal blood pressure readings were grouped according to the type of anesthetic solution used: group I (2% lidocaine with epinephrine 1:80,000), group 2 (3% mepivacaine with epinephrine 1:100,000), and group 3 (3% mepivacaine with no associated vasoconstrictor).[24] According to Silvestre et al,[1,24] the use or nonuse of a vasoconstrictor with the local anesthetic solution exerts no effect on blood pressure in normotensive or hypertensive patients. The fact that the anesthetic solution was limited to 2.7 mL may explain the absence of hemodynamic alterations in the present study as in the work of Santos et al.[22]

Monitoring vital constants is required to rapidly correct possible hypoxia in patients subjected to oral surgery with intravenous sedation or anesthesia.[4,60,61] Minor fluctuations in vital signs are common during the administration of the local anesthetic.[30] In the present study, the cardiovascular parameters analyzed were blood pressure levels (systolic, diastolic, and mean), heart rate, PRQ, RPP, and SpO_2 before and during the surgery as well as after the suturing. Despite the statistically significant difference in PRQ between groups at T1, T2, and T3, this result did not represent a consistent change in vital signs observed at baseline, right after the injection of the first anesthetic cartridge, 5 minutes later, or after suturing the surgical wound in either the L100 or A100 group (Figs. 1–6).

Transient increases and decreases in blood pressure, heart rate, SpO_2, RPP, and PRQ were observed but were not clinically significant. Only the change in PRQ proved statistically significant between groups. These results are in agreement with those reported in previous studies[1,4–7,14–19,21,22,24] that found no statistically significant differences in blood pressure, heart rate, or SpO_2 attributable to the type of local anesthetic used. It is important to note that the present results were obtained when identical volumes of both anesthetic agents were used (2.7 mL), thereby minimizing the bias, as performed in the studies carried out by Colombini et al[5] and Santos et al.[22]

Regarding RPP, a relationship is thought to exist between this parameter and cardiac ischemia.[3,13,17] Patients in the American Society of Anesthesiologists physical status II category had a higher incidence of RPP and PRQ abnormalities. However, it is not known which of these 2 measures is a more sensitive indicator of increased risk associated with stimulation of the sympathetic-adrenergic axis during oral surgery performed with patients under local anesthesia.[3] Knoll-Köhler et al[13] concluded that tooth extraction was a stressful event when the 1:200,000 epinephrine–containing anesthetic solution was used, showing that the risk of inducing a cardiovascular incident and higher level of RPP during oral surgery seems to be higher the greater the extent of operation and the lower the epinephrine dose in the anesthetic solution. In the present study, RPP behaved differently at all evaluation times with both anesthetic solutions. Mestre Aspa et al[17] report an increased value before an injection of the anesthetic solution of lidocaine or articaine, followed by a drop immediately following administration. The present findings are in disagreement with this, as the RPP value rose following the administration of the anesthetic.

Pressure rate quotient is the most widely parameter used as an indicator of cardiac ischemia.[3,13,17,26] Pressure rate quotient of less than 1 is associated to subendocardial ischemia.[17] However, the use of PRQ is not widely accepted as an indicator of myocardial ischemia in humans.[62] Myocardial ischemia occurs when blood flow to the heart is decreased by a partial or complete blockage of an artery, which reduces the oxygen supply in the heart. The classic symptoms of acute myocardial infarction include sudden chest pain (typically radiating to the left arm or left side of the neck), shortness of breath, nausea, vomiting, palpitations, sweating, and anxiety (often described as a sense of impending doom).[63] In the present study, PRQ was the only variable with a statistically significant difference between L100 and A100 after local administration (T1 and T2) and after

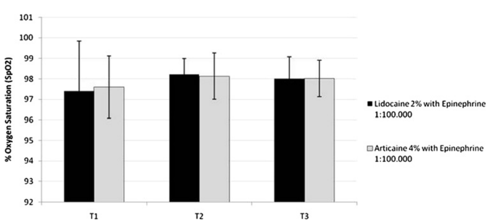

FIGURE 4. Mean percentage of SpO_2 in patients under 2% lidocaine and 4% articaine—both with epinephrine 1:100.000—at 4 different evaluation times; bars demonstrate SD (+/−) in each group. Measurement periods: immediate preoperative (T0), immediately after the regional anesthetic block (T1), 5 minutes later (T2), and after suturing (T3). Oxygen saturation is defined as the ratio of oxygen bound to hemoglobin of the total concentration of hemoglobin present in the blood.

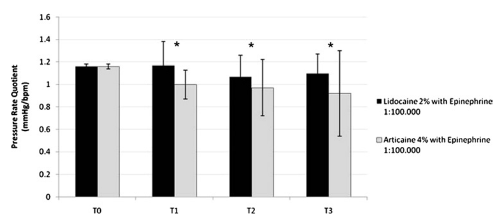

FIGURE 6. Mean PRQ (mm Hg per beats/min) in patients under 2% lidocaine and 4% articaine—both with epinephrine 1:100.000—at 4 different evaluation times; bars demonstrate SD (+/−) in each group; asterisks indicate significant differences between groups ($P < 0.05$). Measurement periods: immediate preoperative (T0), immediately after the regional anesthetic block (T1), 5 minutes later (T2), and after suturing (T3). Pressure rate quotient is calculated by dividing mean blood pressure by heart rate.

suturing (T3). This finding is in disagreement with that described by Mestre Aspa et al,[17] who found no significant difference between the anesthetic solution used or the surgical phase involved.

According to Campbell and Langston,[3] only patients with simultaneously abnormal RPP and PRQ values are at a significant risk of suffering cardiac ischemia, which would moreover have to be confirmed electrocardiographically. Accordingly, it would be advisable to monitor all patients with known cardiovascular disease or arterial hypertension programmed for oral surgery or potentially painful procedures.[17] Therefore, as the only significant difference was the effect on PRQ, no perceptible clinical changes were noticed during the surgeries.

It is important to highlight that local anesthetics are recommended for patients with hypertension because they can decrease pain and increase comfort.[64] True allergy is the only contraindication for the use of such anesthetics. The selection of a local anesthetic solution is based primarily on the duration of the procedure, the need for hemostasis, and the required degree of pain control.[65] Vasoconstrictors are added to local anesthetics to aid in hemostatic control and to increase the duration of the drug's effect. A solution of 2% lidocaine with 1:100,000 epinephrine is the formulation most commonly used to achieve the necessary degree of anesthesia for most dental situations.[66] A risk in the administration of local anesthesia for the hypertensive patient is the inclusion of epinephrine and its sympathomimetic effect on cardiac β1 receptors. The current maximum recommended dose of local anesthetic solution for a patient with hypertension (poorly controlled American Society of Anesthesiologists class III or all class IV) is 2 1.8-mL cartridges (for a total dose of 3.6 mL) with 1:100,000 epinephrine per appointment.[67,68] If lengthy procedures are anticipated, the epinephrine should be diluted to a ratio of 1:200,000.[67] Niwa et al[69] showed that patients with mild cardiovascular disease can withstand a dose of 1.8 mL of 2% lidocaine with 1:80,000 epinephrine without cardiovascular hemodynamic complications. According to Bader et al[70] in a systematic review of cardiovascular effects of epinephrine on hypertensive dental patients, although the increased risk for adverse events among uncontrolled hypertensive patients was found to be low, and the reported occurrence of adverse events in hypertensive patients associated with the use of epinephrine in local anesthetics was minimal, the quantity and quality of the pertinent literature are problematic.

A certain increase in systolic blood pressure can be noted at the moment of tooth extraction and at the end of the procedure.[1,24] This has been attributed to increased patient anxiety during extraction, taking into account that the difference is comparatively greater between systolic blood pressure at the start of the procedure and at the actual moment of extraction. Although hemodynamic variables were not recorded at this moment in the present study, previous studies comparing lidocaine and articaine with epinephrine 1:100,000 report that pressure levels before surgery are similar to those found after suturing.[17,19]

It appears that, in a certain portion of the patient population, anxiolysis or other advanced pain control besides local anesthetic would be beneficial. The control of pain and anxiety is fundamental to the practice of dentistry, and yet the use of conscious sedation in dentistry is very variable among dentists. There is need to have a tool to support clinicians in their decision making about conscious sedation. Moreover, it is necessary to identify patients who need conscious sedation for dental treatment to plan and deliver appropriate sedation services.[71,72] According to Coulthard et al,[72] conscious sedation need could be assessed by ranking a combination of information on patient anxiety, medical history, and the complexity of the clinical treatment. In our study, only individuals with absent or minimal anxiety were included by applying the MDAS. Therefore, our results for preoperative and prelocal anesthetic hemodynamic parameters were quite similar corroborating with works that found significant hemodynamic alterations in patients with moderate and severe anxiety.[37,38]

The volume of anesthetic solution used in the present study was less than that reported by Mestre Aspa et al,[17] who used 3.6 mL or less in 17 of the 45 patients, and the remaining 28 cases received a volume ranging from 3.6 to 5.4 mL. Moreover, a previous study reports no significant mean changes in blood pressure during dental treatment among patients having received articaine.[7] However, Silvestre et al[1] found significant differences only in systolic blood pressure measured before and after dental extraction in the group of hypertensive patients anesthetized with 4% articaine with epinephrine 1:200,000.

Troullos et al[27] found that the administration of 8 cartridges of 2% lidocaine with 1:100,000 epinephrine (144 μg epinephrine) significantly increased hemodynamic parameters in patients undergoing the surgical removal of 4 impacted third molars. The authors also found a significant increase (>27-fold) in plasma epinephrine levels. Moreover, Santos et al[22] used a small therapeutic volume of A100 or A200 (2.7 mL) and reported relatively transient cardiovascular effects in healthy individuals, which the authors attribute to the small amount of epinephrine contained in both solutions (27 and 13.5 μg, respectively). The present study corroborates this finding, as no significant variation in hemodynamic parameters was found with either L100 or A100 at a volume of 2.7 mL.

According to a number of authors, oral surgery implies significant patient stress, triggering the release of a considerable amount of endogenous catecholamines, which would be responsible for the small hemodynamic fluctuations observed rather than the epinephrine habitually associated in the local anesthetic solution used.[11,17,32] However, in a study on blood pressure fluctuations in hypertensive patients during different oral surgical procedures, Meiller et al[16] found no such correlation between patient stress and changes in hemodynamic variables.

It is worth mentioning that none of the present results were influenced by the type or concentration of the vasoconstrictor substance associated to the local anesthetics used, as both contained 1:100,000 epinephrine. Many authors[13,27,28,32,73] state that the amount of epinephrine administered with the local anesthetic formulation exerts a cumulative effect with plasma catecholamine levels, although this phenomenon would not suffice to induce hemodynamic changes in young healthy individuals, such as those in the present study. However, in patients with cardiovascular disease, the risk of complications attributable to this mechanism increases. Systematic monitoring of such patients is therefore advisable.[3,8,13,17,21,26,32]

CONCLUSIONS

The hemodynamic parameters evaluated in third molar surgery with 2% lidocaine and 4% articaine (both with epinephrine 1:100,000) did not show significant differences. Moreover, the present study lends support that equal quality of anesthesia and pain control can be obtained with 2% lidocaine when compared with the more risky 4% articaine, at least when monitored with hemodynamic changes.

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Synovial Chondromatosis of the Temporomandibular Joint: Radiologic and Histopathologic Findings

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Abstract: Synovial chondromatosis is a formation of multiple intrasynovial nodules resembling osteochondromas, resulting from

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