

Study of articaine diffusion into the pulp of maxillary teeth and to the palate

Estudo da difusão da articaína na polpa de dentes maxilares e no palato

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ABSTRACT

Objective

The purpose of this study was to assess if 4% articaine with 1:100,000 epinephrine (DFL®, Rio de Janeiro, Brazil) provides the necessary diffusion to anesthetize dental pulps innervated by the anterior and medium branches of the superior alveolar nerve as well as the nasopalatine region after posterior superior alveolar nerve block.

Methods

In this descriptive and quantitative study, selected total of 30 patients was selected, with healthy superior-lateral incisors and first premolars, who were submitted to cold testing of the pulp, puncture of the nasopalatine region and identification of the stimuli on the visual analogue Faces Pain Scale. This procedure was repeated in two stages, four minutes and eight minutes after the posterior superior alveolar nerve block with articaine.

Results

Eight minutes after the injection, 50% of patients reported complete absence of pain (score zero) in the lateral incisor tested, 80% in the premolar and 36.67% in the nasopalatine region. No statistically significant diffusion was recorded in either gender ($p = 0.26$) or between different age groups ($p=0.29$).

Conclusion

Diffusion did not occur with the expected intensity in all patients, which does not exclude the use of anesthetic block on these nerves when an intervention is needed in the region.

Indexing terms: Carticaine. Diffusion. Maxillary nerve.

RESUMO

Objetivo

Avaliar se a articaína a 4% com epinefrina 1:100.000 (DFL®, Rio de Janeiro, Brazil) apresenta uma difusão capaz de insensibilizar as polpas dentárias inervadas pelos ramos médio e anterior do nervo alveolar superior e insensibilizar, também, a região nasopalatina, quando utilizado o bloqueio anestésico do nervo alveolar superior posterior.

Métodos

Neste estudo descritivo e quantitativo, foram selecionados 30 pacientes com incisivo lateral superior e primeiro pré-molar superior hígidos, os quais foram submetidos a teste pulpar a frio e punção na região nasopalatina e identificação dos estímulos na Escala de Faces de Dor. Este procedimento foi repetido em duas etapas: com quatro minutos e oito minutos após o bloqueio do nervo alveolar superior posterior com articaína.

Resultados

Em seguida aos testes de sensibilidade, verificou-se que após oito minutos da anestesia por bloqueio, 50.00% dos pacientes referiram ausência de dor (escore zero) no incisivo lateral testado, 80.00% no pré-molar e 36,67% na região nasopalatina. Não foi registrada difusão estatisticamente significativa em relação aos sexos ($p = 0,26$) e entre as faixas etárias analisadas ($p = 0,29$)

Conclusão

Esta difusão não ocorreu em todos os pacientes com a intensidade esperada, o que não descarta o uso do bloqueio destes nervos quando houver necessidade de intervenção na região.

Termos de indexação: Carticaína. Difusão. Nervos maxilares.

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INTRODUCTION

Articaine was developed in 1969 by H. Rusching and introduced to the market in 1976, in Germany, according to Haase et al.¹. According to Steele et al.², this drug is classified as an amide local anesthetic, such as lidocaine, mepivacaine, prilocaine and bupivacaine. However, it is the only amide anesthetic that contains a thiophene ring instead of a benzene ring, which accords it more liposolubility, resulting in high tissue penetration and diffusion³⁻⁵.

It also has an extra ester link in its molecule, which makes it possible for it to be biotransformed, not only in the liver but also in tissues and plasma⁶⁻⁷ resulting in a half-life of about 20 minutes, thereby suggesting low toxicity⁸.

The posterior superior alveolar nerves innervate the pulp and periodontium of maxillary molars and palatal nerves transmit sensitivity from the palatal mucosa⁹. Due to the close bond between palatal mucosa and its underlying periosteum and its abundant nerve supply, the anesthetic injection can be very painful¹⁰.

An anesthetic, such as articaine, of medium duration and with high power of diffusion in oral tissue, is necessary in order to supplant these types of anesthesia. If this potential for diffusion is capable of desensitizing regions which the initially anesthetized nerves do not innervate, articaine anesthesia would considerably decrease the discomfort felt by patients, making dental treatment under local anesthesia less stressful and more comfortable, reducing the number of injections and quantity of drug used. The purpose of this study was to assess if articaine 4% with epinephrine 1:100,000, when used to anesthetize the posterior superior alveolar nerve block, presents a diffusion capable of desensitizing pulps innervated by the middle and anterior branches of the superior alveolar nerve and the nasopalatine region.

METHODS

This study aims to provide a descriptive and quantitative analysis of the diffusion of articaine 4% with epinephrine 1:100,000 (DFL®, Rio de Janeiro, Brazil) diffusion in the maxilla after posterior superior alveolar nerve block.

After approval from the Research Ethics Committee of the Federal University Hospital of Sergipe, protocol number CAAE: 0100.0.107.000-07, we selected 30 adult volunteer patients, aged between 20 and 30, who sought dental care at the Dental Clinic of the Federal University of Sergipe, with a referral for dental procedures in the superior molar region. The patients should have, in the same quadrant where the dental investigation was to be conducted, a healthy first superior premolar and superior lateral incisor.

The selected patients were made aware of the research objectives and signed Informed Consent Agreements for the clinical research, in accordance with National Health Council Resolution 196/96. After the patients had signed up for the research, they were subjected to an anamnesis, which was performed by way of questioning and data collection on a standard chart. Then the patient underwent clinical examination, performed using inspection and palpation, in order to identify indications and therapeutic dental conditions which would confirm eligibility or, alternatively, exclude them from participating in the study.

The following patients were excluded from this research: Those who were diagnosed, during anamnesis and clinical examination, with alcoholism, drug use, use of anti-histamines and/or anti-depression medication, diabetes, hypertension, pregnancy, dental phobia, children, allergic to any component in the formula and/or allergic to sulfa drugs.

Once the inclusion criteria were confirmed, the patients were submitted to a clinical session to perform the dental treatment recommended, where each patient was submitted to a pulp vitality test through contact, of approximately one second duration, with the refrigerating spray (Endo-ice-50°C Maquira®, Maringá, Brazil), which cools to around -50° Celsius, with the first premolar and lateral incisor and also a puncture with a 27G needle (DFL®, Rio de Janeiro, Brazil) in the nasopalatine region near the lateral incisor. The side selected for the sensitivity tests was the same side on which the dental procedure was to be performed. The pain perceived by the patient was measured and recorded by the patient on a Faces Pain Scale (Figure 1) according to the sensitivity at the baseline (pre-anesthesia) procedure. On that scale, scores ranged from 0 to 5, where a score of zero corresponded to no pain and five to the maximum pain.

With the patient comfortably seated in the dental chair in a supine position, he/she was given the anesthetic.

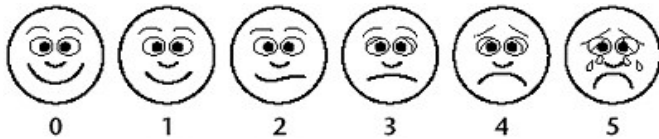


Figure 1. Faces pain scale.

The participant was asked to gargle for one minute with 5ml of chlorhexidine digluconate 0.12% for oral antiseptis. Before the actual anesthetic procedure, topical anesthetic (Benzocaine 5% DFL®, Rio de Janeiro, Brazil) was applied to the region corresponding to the needle injection. We carried out the technique that uses a posterior superior alveolar nerve block injection of one tube (1.8 ml) of the anesthetic with epinephrine 1:100,000 articaine using an aspirating carpule syringe and 27G needle (DFL®, Rio de Janeiro, Brazil), thereby guaranteeing the non-intravascular injection of the substance.

After a negative response to aspiration, we proceeded to administer one tube (1.8 ml) of articaine 4% with epinephrine 1:100,000 (DFL®, Rio de Janeiro, Brazil). The anesthetic procedure was slow and continuous, with an injection velocity of approximately 1.0 ml per minute. There was, therefore, an interval of approximately two minutes to administer the entire contents of the tube.

After four minutes, the stimuli with refrigerating spray on the selected teeth and with needle to the palate were repeated, and the patient underwent a fresh evaluation and recorded the result on the Faces Pain Scale. New stimuli were also performed and records made eight minutes after anesthesia, and then the dental treatment commenced. All the steps were performed by just one

researcher, who used the same anesthetic technique and the same technique for applying the refrigerating spray and needle injection.

After the data were collected, they were tabulated using Microsoft Excel 2003 software, at the Statistics Service of the Federal University of Sergipe and submitted for assessment and statistical analysis by Chi-square test. The Cramer's V indicator was utilized to assess the degree of dependence between variables. Data were considered statistically significant when $p < 0.05$.

RESULTS

Thirty dental procedures were performed under local anesthetic using articaine 4% with adrenaline 1:100,000 (DFL®, Rio de Janeiro, Brazil) on 30 patients, 15 men and 15 women. The age range varied between 20 and 29 with a mean age of 21.8 and there were no statistically significant differences in the sensitivity test results between gender ($p=0.0026$) and the age range analyzed ($p=0.0029$). The results of pain sensitivity in the three evaluations (pre-anesthesia, 4 minutes and 8 minutes after anesthesia) are shown in Table 1.

In the pre-anesthesia stage, none of the patients reported zero pain (score 0) or minimal pain (score 1), having marked scores of two, three, four and five, a variation that testifies to the subjective character of pain sensitivity. With four minutes of anesthesia, 53.33% of patients felt no pain in the first premolar, 20.00% felt no pain in the superior lateral incisor and 10.00% did not feel the nasopalatine

Table 1. Distribution of patients (%) according to pain score in each region evaluated in pre-anesthesia and 4 min. and 8 min. after anesthesia, to the posterior superior alveolar nerve with a solution of 4% articaine with 1:100,000 epinephrine.

Pain Scale	Evaluation (%)								
	Pre-anesthesia			4 mins. after anesthesia			8 mins. after anesthesia		
	LI	1 st PM	Palate	LI	1 st PM	Palate	LI	1 st PM	Palate
Zero	0	0	0	20.00%	53.33%	10.00%	50.00%	80.00%	36.67%
One	0	0	0	33.33%	30.00%	36.67%	40.00%	20.00%	36.67%
Two	20.00%	16.67%	0	20.00%	3.33%	13.33%	10.00%	0	13.33%
Three	46.67%	30.00%	50.00%	20.00%	10.00%	30.00%	0	0	13.33%
Four	20.00%	33.33%	26.67%	6.67%	3.33%	10.00%	0	0	0
Five	13.33%	20.00%	23.33%	0	0	0	0	0	0
Total	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%

LI: Superior lateral incisor. 1st PM: First superior premolar.

region. After eight minutes of anesthesia, 80.00% reported lack of sensitivity in the first premolar, followed by 50.00% in the lateral incisor and 36.67% in the nasopalatine region.

The indicator of the degree of association between variables, Cramer's V, pointed to a mean co-dependence between variables of 65.4%.

DISCUSSION

There were no complications as a result of the anesthetic solution administered in any of the procedures performed, which corroborates the data from Petrikas et al.¹¹ and Sherman et al.¹², who stated that articaine is a safe anesthetic when used in the appropriate dosage.

The cold thermal testing was used in this study to provide high reliability, ensure no contraindications, to have to be comfortable for the patient and also cost-effective in addition to being easy to perform¹³. According to a study by Medeiros and Pesce¹⁴, this is the method of choice for the evaluation of vitality. As the tests were conducted at intervals of 4 minutes, the nerve fiber has enough time to recover without interfering with the outcome of the next test. If a shorter interval is required, the electrical test would be ideal, since in this case, the nerve fiber recovers within 2 minutes¹⁵⁻¹⁶.

Articaine, like other local anesthetics, should always be used in combination with a vasoconstrictor, due to its vasodilatory properties, and this must be the lowest acceptable concentration to reduce the risk of adverse effect⁶. Some authors, like Silva et al.¹⁷ and Santos et al.¹⁸, relate in their writings that articaine with 1:200,000 epinephrine should be the solution of choice for cardiac patients or when extracting third molars, because it has properties similar to an epinephrine concentration of 1:100,000 and is less concentrated. In this study, however, a solution of 4% articaine with 1:100,000 epinephrine was used because, according to studies, Meehan¹⁰, Srinivasan et al.¹⁹ and Colbert et al.²⁰ it is a safe association and slightly higher than the solution of 4% articaine with epinephrine 1:200,000 for the duration of the anesthesia and haemostasis, and also because all procedures were performed in patients without apparent systemic involvement.

Works such as Jung et al.³, Evans et al.⁵, Petrikas et al.¹¹ and Colbert et al.²⁰ aimed to compare the various aspects of articaine (onset time, duration of anesthesia, tissue distribution) with other amide anesthetics in order to determine which anesthetic solution is safer and more efficient. No statistically significant results were obtained in favor of a specific anesthetic such as lidocaine, prilocaine or mepivacaína, although slight superiority has been commonly reported with articaine.

The time between anesthesia and the beginning of the tests was four minutes, similar to the five-minute period adopted in the work of Lima Júnior et al.²¹ and Fan et al.²². According to Lima Júnior et al.²¹, in extractions of upper teeth using articaine, supplementary palatine anesthesia was unnecessary in 93.6% of cases, it being sufficient to apply only vestibular anesthesia. This is due to the fact that articaine is the only anesthetic amide with a thiophene ring, which gives greater lipid solubility resulting in high tissue penetration and diffusion³⁻⁷.

In the present study, anesthetic diffusion was tested in anatomically distant regions. After eight minutes of anesthesia, it was found that in 80% of patients, most of them experienced numbness in the first premolar tooth often innervated by the middle superior alveolar nerve. Although we found a high level of diffusion of anesthesia, we must consider that, in 30% of the population, the middle superior alveolar nerve is absent and, in these cases, the innervation is performed by the posterior superior alveolar nerve¹¹. Considerable diffusion was also observed in the lateral incisor, which is innervated by the anterior superior alveolar nerve, where 50% of patients had no complaint of pain following eight minutes of anesthesia. And even now, 36.67% reported anesthesia in the nasopalatine region, which is innervated by the nasopalatine nerve.

However, when practicing dentistry, absence of pain is an essential resource for patients because it results in an unarguably superior comfort situation, and for the professionals too, as it makes it possible to act as and how the treatment dictates, knowing that he/she is not causing suffering²³. Although statistically significant, the data from this study did not present, for most individuals, sufficient results to perform dental procedures without pain in other areas supplied by different nerves of the posterior superior alveolar nerve

CONCLUSION

It can be concluded that articaine presents a statistically significant diffusion in the maxilla that comes to desensitize the middle, anterior and nasopalatine branches faced with a blockage of the posterior superior alveolar nerve. Nevertheless, this diffusion did not occur in all patients with the expected intensity, which does not exclude the use

of blocking these nerves when there is a need for intervention in the region.

Colaborators

AO RIBEIRO - contribution: data collection and editing the article. CES SILVEIRA - contribution: data collection and statistical analysis. LMA SOUZA - contribution: bibliographic survey and discussion.

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