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Evaluation of the buccal vestibule-palatal diffusion of 4% articaine hydrochloride in impacted maxillary third molar extractions

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Abstract

Aims: The aim of this study was to evaluate the vestibular-palatal diffusion of 4% articaine with epinephrine 1:100,000 and 1:200,000, in impacted maxillary third molar extractions, without palatal injection. Materials and Method: Two hundred teeth were selected from patients age 15 to 46. Patients were divided into 4 groups: 1A, were anesthetized with 4% articaine 1:100,000 and the surgery was initiated 5 minutes following anesthesia. 1B, used 4% articaine 1:100,000 but the surgery was started 10 minutes after anesthesia. 2A, used 4% articaine 1:200,000 the surgery was started 5 minutes after. 2B, used 4% articaine 1:200,000 but 10 minutes was allowed for anesthetic diffusion before the initiation of in groups (50 extractions each) only buccal vestibule anesthesia was initially administered (i.e. no palatal injections were used). Results: The rate of sufficient vestibule-palatal diffusion, as determined by the lack of necessity of supplemental palatal anesthesia, was: 1A(84%), 1B(98%), 2A(78%), 2B(82%). Chi-square (X2) and residual analyses showed that a higher vestibule-palatal diffusion was obtained using 4% articaine 1:100,000 with a period of 10 minutes ($p<0.05$). Conclusions: Most of the extractions could be performed only with vestibule anesthesia. However, vasoconstrictor concentration and the time interval between administration of the anesthetic and initiation of surgery did influence buccal vestibule-palatal diffusion of 4% articaine in the extraction models used.

Key words: *Articaine, diffusion, palatal injection, oral surgery.*

Introduction

Due to a dense vascularization and innervation of the palatal mucosa, as well as, its strong attachment to bone, palatal local anesthesia injections are frequently associated with at least some level of discomfort. In the search for alternatives to circumvent this problem a number of studies have investigated the utilization of articaine hydrochloride as a means of minimizing the use of palatal anesthesia in dentistry (1,2).

Articaine hydrochloride is an amide-type local anesthetic, which is unique among clinically used local anesthetics in that its lipophilic moiety is a thiophene ring with an ester side-chain. There is at least some evidence suggesting that it is the local anesthetic that best diffuses within soft and hard tissues (2-6). The factors that contribute to this however are poorly understood.

The articaine has pH of 4.4 and 5.2 associated to the epinephrine 1:100,000, and 4.6 and 5.4 associated to the epinephrine 1:200,000. The pKa is of 7.8 in both concentrations of vasoconstrictor and its latency to 1 of 3 minutes (7-10). In the present research a time of latency of 5 and 10 minutes was allowed. These times had demonstrated to be necessary so that the diffusion occurred to the vestibule-palatal of articaine (2,3).

Some studies have evaluated the vestibule-palatal diffusion of the articaine in extractions only with the vestibular anesthesia, without the palatal complementation (2,5,11).

The aim of this study was to evaluate the vestibular-palatal diffusion of articaine hydrochloride 4% associated with either epinephrine 1:000,000 or epinephrine 1:200,000 in impacted maxillary third molar extractions using only vestibule infiltrative terminal anesthesia without, therefore, palatal injections.

Materials and Methods

The following research protocol was previously approved by the Ethics Committee of the State Health's, Department of João Pessoa, Paraiba, Brazil. One was to a clinical research, the transversal, daily pay-experimental type, with primary data. The literature researched ranged throughout the years of 1987 to 2006.

Two hundred impacted maxillary third molars were selected from 15 to 46 year-old patients of both sexes and their removal carried out using only buccal vestibule terminal infiltrative anesthesia (without palatal injection) with 1.8 ml of articaine hydrochloride 4% under the four following conditions: Group 1A-50 extractions utilizing articaine hydrochloride with epinephrine 1:100,000 (Articaine® - DFL) with an interval of 5 minutes between anesthesia and the start of surgery (time for anesthetic diffusion). Group 1B-50 extractions utilizing articaine with epinephrine 1:100,000 with a time period of 10 minutes between anesthetic administration and initiation of surgery. Group 2A-50 extractions using articaine hydrochloride with epinephrine 1:200,000 (Septanest® - SEPTODONT) and an interval of 5 minutes between anesthesia injection and commencement of surgical procedures and, Group 2B-50 extractions utilizing articaine with epinephrine (1:200,000 waiting for 10 minutes following anesthesia to start the extractions).

Each surgery was performed by a single operator. Initially vestibule infiltrative anesthesia was administered to the upper right third molar region. After a time period of either 5 or 10 minutes the surgical procedure for tooth removal was initiated. The adequacy of anesthesia was determined at each surgical phase by the presence or absence of pain as indicated by the patient according to a pre-established protocol. In those cases where pain control was not adequate by vestibule infiltration anesthesia alone, supplemental palatal anesthesia was performed and the surgical procedure continued. The patients were fully conscious during surgery and able to communicate normally. No form of systemic sedation or block anesthesia was utilized (2,3).

Significant differences between experimental groups were investigated by Chi-Square (X2) tests and residual analysis with a level of significance set at $p< 0.05$. This was carried out using GraphPad Prism software (GraphPad Software, San Diego-CA, USA).

Results

The vestibule-palatal diffusion of articaine hydrochloride 4% associated with epinephrine at two different concentrations (1:100,000 and 1:200,000) was compared. A comparison was also made relative to two different time intervals allowed between the administration of the anesthetic and start of surgery (5 and 10 minutes). The rate of success was determined by the number of extractions performed without the need for supplemental palatal injections.

The absolute numbers and percentages of extractions performed with and without the need for supplemental palatal anesthesia according to the different vasoconstrictor concentrations and intervals between administration of the anesthetic and initiation of surgery (time for anesthetic diffusion) (Table 1).

Chi-Square (X2) revealed a significant correlation between the different anesthesia regimens and the need for supplemental palatal injection, Chi-Square(X2) = 9.3023; P=0.025. The residual analysis indicated that in the group 1B the need for supplemental palatal injection was significantly lower that in the other groups ($P<0.01$).

The frequency of the presence or absence of pain (regardless of intensity or need for supplemental palatal injection) at each individual surgical phase according to the different conditions evaluated (Table 2).

Table 1. Efficacy of articaine hydrochloride 4% vestibule-palatal diffusion associated with epinephrine 1:100.000 or 1:200.000 and with different time periods for anesthetic diffusion (n=200).

Groups		Frequency	Valid percentage	Accumulative percentage
Group 1A 5 minutes 1:100.000	Without palatal anesthetic supplementation	43	86,0	86,0
	With palatal anesthetic supplementation	7	14,0	100,0
	Total	**50**	**100,0**	
Group 2A 5 minutes 1:200.000	Without palatal anesthetic supplementation	39	78,0	78,0
	With palatal anesthetic supplementation	11	22,0	100,0
	Total	**50**	**100,0**	
Group 1B 10 minutes 1:100.000	Without palatal anesthetic supplementation	49	98,0	98,0**
	With palatal anesthetic supplementation	1	2,0	100,0
	Total	**50**	**100,0**	
Group 2B 10 minutes 1:200.000	Without palatal anesthetic supplementation	41	82,0	82,0
	With palatal anesthetic supplementation	9	18,0	100,0
	Total	**50**	**100,0**	

Table 2. Presence or absence of pain at the various surgical phases according to vasoconstrictor concentration and anesthetic diffusion time (n=200).

Anesthetic diffusion time groups	Vasoconstrictor Concentration	Pain at the moment of the operative procedure	Frequency	Relative frequency percentage
Group 1A 5 minutes	1:100.000	NO PAIN INCISION EXTRACTION SUTURE	39 3 4 4	78,0 6,0 8,0 8,0
Group 1B 10 minutes	1:100.000	NO PAIN EXTRACTION SUTURE	47 1 2	94,0 2,0 4,0
Group 2A 5 minutes	1:200.000	NO PAIN INCISION EXTRACTION SUTURE	34 1 10 5	68,0 2,0 20,0 10,0
Group 2B 10 minutes	1:200.000	NO PAIN INCISION EXTRACTION SUTURE	36 2 7 5	72,0 4,0 14,0 10,0

Discussion

There are still relatively few studies that strongly substantiate the purported high vestibule–palatal diffusibility of articaine hydrochloride (12-15). However the results of this study indicate that articaine has indeed high vestibule-palatal diffusion and that in fact in most cases supplemental palatal injection is not necessary (2-6,11,16).

In all groups a few patients complained of pain during suturing when the needle perforated the palatal mucosa. This pain, however, was considered mild and not one patient accepted supplemental palatal injection, more commonly citing that the latter would probably be more painful than the slight discomfort produced by suturing. The reason or reasons why these patients felt pain only at the suturing stage of surgery merit further investigation.

The results of this study also indicate that articaine hydrochloride 4% with epinephrine 1:100,000 produces more effective buccal vestibule-palatal anesthesia than the 1:200,000 solution, when an interval of 10 minutes is allowed between the administration of the anesthetic and the initiation of surgery. This strongly suggests that vasoconstrictor concentration may influence anesthetic diffusion. It may be that due to a slower absorption rate the anesthetic with epinephrine 1:100,000 is available at a higher initial concentration for diffusion (forming a higher concentration gradient) than the 1:200,000 solution. Alternatively, the former may simply stay longer in the vicinity of the neural fibers leading thus to a more efficient pain control.

Conclusions

1. Articaine hydrochloride 4% demonstrated relatively good vestibule-palatal diffusion in the 4 test groups analysed, with efficacy rates of anesthesia of 78% (2A), 82% (2B), 86% (1A) and 98% (1B).

2. Retained maxillary third molar extractions could be performed with only buccal vestibule infiltrative terminal anesthesia in the majority of cases, with no need for supplemental palatal injections.

3. Vasoconstrictor concentration as well as the time interval between anesthetic administration and start of surgery influenced tissue diffusion, as shown by the greater efficacy of the articaine hydrochloride 4% with epinephrine 1:100,000, 10 minutes group.

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