A Comparison of the Anesthetic Efficacy of Articaine and Lidocaine in Patients with Irreversible Pulpitis

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Abstract

The purpose of the present study was to compare the anesthetic efficacy of 4% articaine with 1:100,000 epinephrine with that of 2% lidocaine with 1:100,000 epinephrine during pulpectomy in patients with irreversible pulpitis in mandibular posterior teeth. Forty volunteers, patients with irreversible pulpitis admitted to the Emergency Center of the School of Dentistry at the University of São Paulo, randomly received a conventional inferior alveolar nerve block containing 3.6 mL of either 4% articaine with 1:100,000 epinephrine or 2% lidocaine with 1:100,000 epinephrine. During the subsequent pulpectomy, we recorded the patients' subjective assessments of lip anesthesia, the absence/presence of pulpal anesthesia through electric pulp stimulation, and the absence/presence of pain through a verbal analogue scale. All tested patients reported lip anesthesia after the application of either inferior alveolar nerve block. Regarding pulpal anesthesia success as measured with the pulp tester, the lidocaine solution had a higher success rate (70%) than the articaine solution (65%). For patients reporting none or mild pain during pulpectomy, the success rate of the articaine solution (65%) was higher than that of the lidocaine solution (45%). Yet, none of the observed differences between articaine and lidocaine were statistically significant. Apparently, therefore, both local anesthetic solutions had similar effects on the patients with irreversible pulpitis in mandibular posterior teeth. Neither of the solutions, however, resulted in an effective pain control during irreversible pulpitis treatments. *(J Endod 2009;35:165–168)*

Key Words

Articaine, inferior alveolar nerve block, irreversible pulpitis, lidocaine

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The inferior alveolar nerve (IAN) block is certainly the most used mandibular injection technique to achieve local anesthesia for dental treatments. However, clinical studies have demonstrated significant failure rates of this technique (1, 2), which indicates that IAN blocks, even if applied appropriately, do not always result in successful pulpal anesthesia (1, 3). This failure rate of IAN blocks represents a common clinical problem for the treatment of mandibular posterior teeth with irreversible pulpitis (4–7).

Articaine, which has recently been introduced in Brazil and the United States (8, 9), is the most commonly used local anesthetic in Canada (10) and in several European countries (11). In Germany, for instance, it accounts for 80% of all local anesthetics used for endodontic treatments (12, 13). Because articaine is a comparatively new anesthetic, it still is the center of heated discussions among dental surgeons. Thus, for instance, Malamed et al. (9) speculated that articaine has a faster onset and higher success rates than lidocaine. On the other hand, Haas and Lennon (10) have demonstrated that articaine increased the risk of paresthesia. This finding, however, could not be confirmed in a recent study by Pogrel (14).

Although articaine has been speculated to have some advantages over lidocaine (9), clinical researchers, with the exception of 4 recent studies on mandibular (15–17) and maxillary infiltration (18), failed to demonstrate a superiority of articaine over lidocaine regarding its anesthetic efficacy in mandibular (8, 9, 19, 20) and maxillary (21–23) teeth.

So far, research on the effect of articaine in patients with irreversible pulpitis is very limited (19, 20, 24). Therefore, to contribute to a more profound knowledge about the quality of articaine as local anesthetic for endodontic treatments, the purpose of the present study was to compare the anesthetic efficacy of 4% articaine with 1:100,000 epinephrine with 2% lidocaine with 1:100,000 epinephrine for IAN blocks in patients with mandibular posterior teeth experiencing pulpitis.

Materials and Methods

Forty adult patients (n = 40) participated in this prospective, randomized, double-blind clinical study. The patients had been admitted to the Emergency Center of the School of Dentistry at the University of São Paulo with a clinical diagnosis of irreversible pulpitis, ie, they had moderate to severe spontaneous pain and exhibited a positive response to the electric pulp test and a prolonged response to cold testing with Endo-Frost (Coltene-Roeko, Langenau, Germany). To qualify for our study, the patients had to be between 18 and 50 years old and in good health as determined by a health history questionnaire. Each participant had at least 1 adjacent tooth plus a healthy contralateral canine or, alternatively, a contralateral canine without deep carious lesions, extensive restoration, advanced periodontal disease, history of trauma, or sensitivity. Patients who took medication potentially interacting with any of the anesthetics used in the study were not included.

The study was approved by the Committee on the Ethics of Research on Human Beings of the School of Dentistry at the University of São Paulo (protocol 95/07), and each patient gave written informed consent to participate in the study.

The 40 participants were divided into 2 groups of 20 patients, who received IAN block injections of 3.6 mL (equivalent to 2 cartridges) of either 2% lidocaine (Alphacaine 100; DFL, Rio de Janeiro, RJ, Brazil) with 1:100,000 epinephrine or 4% articaine (Articaine 100; DFL, Rio de Janeiro, RJ, Brazil) with 1:100,000 epinephrine, respec-

TABLE 1. Types of Teeth with Irreversible Pulpitis (Actual Frequency and Percentage of Afflicted Teeth in Both Experimental Groups and in Total)

Group	Tooth				Total
	1st Molar	2nd Molar	2nd Premolar	3rd Molar	
Articaine	10	8	1	1	20
	50%	40%	5%	5%	100%
Lidocaine	9	5	4	2	20
	45%	25%	20%	10%	100%
Total	19	13	5	3	40
	47.5%	32.5%	12.5%	7.5%	100%

tively. To ensure the blindness of the study, 2 cartridges (3.6 mL) of either anesthetic solution were sealed in envelopes. At the time of application, the senior researcher, who administered the 2 consecutive anesthesia injections, chose 1 of the envelopes at random. Electric pulp stimulations to assess pulpal anesthesia were performed by a postgraduate student to guarantee that the anesthetic solution remained unknown and thus maintain the double-blindness of the study. Two consecutive negative responses to the maximum pulp stimulus (80 μA) were the criterion to determine a pulpal anesthesia as successful.

Before the IAN block injections, the tooth with irreversible pulpitis, the adjacent tooth, and the contralateral canine were tested for pulp vitality with an electric pulp stimulator (Vitality Scanner 2006; SybronEndo, Orange, CA). The electric pulp stimulation of the contralateral canine, which had not been anesthetized, was used as control to ensure that the equipment was working properly and that patients were responding adequately.

For the injections, we used a side-loading carpule syringe, fitted with a 27-gauge 0.4 × 35 mm needle (Teruno Dental Needle; DFL Indústria e Comércio Ltda, Rio de Janeiro, RJ, Brazil) and equipped with a blood aspiration device and a thumb ring (Können; Kennen Indústria e Comércio Ltda, Brazil). Blood aspiration tests were carried out before each anesthesia injection as well as when changing needle position. The 2 cartridges of the respective anesthetic solution were applied as follows. In the first step of the first anesthesia (1 cartridge, 1.8 mL), the needle was introduced 3–5 mm deep, the blood was aspirated, and approximately 0.3 mL anesthetic solution was injected. In the second step, the syringe was directed to the premolar region of the opposite side, where the needle was inserted until establishing bone contact. Thereafter, the needle was withdrawn 1–2 mm, the blood was aspirated, and the remaining 1.5 mL of anesthetic solution was slowly injected. The second anesthesia (1 cartridge, 1.8 mL) was initiated immediately after the second step of the first anesthesia. The average injection time for each cartridge was approximately 2 minutes.

Ten minutes after the IAN block, subjective lip anesthesia was evaluated by asking the patient whether his/her lip was numb. Thereafter and immediately before the pulpectomy, the electric pulp stimulations were repeated to determine pulpal anesthesia. During the pulpectomy procedure, the patients were instructed to report any painful discomfort. To evaluate the intensity of pain during the pulpectomy, a verbal analogue scale was used: 0, no pain; 1, mild, bearable pain; 2, moderate, unbearable pain; 3, severe, intense, and unbearable pain. The anesthesia was defined as successful when the dentist accessed the pulp chamber without pain being reported by the patient (pain scores 0 or 1). In these cases, the pulpectomy procedure was continued. Pain scores of 2 or 3 classified the IAN block as unsuccessful. In these cases, an intrapulpal anesthesia was performed, and the pulpectomy was finalized. This complementary anesthesia was not evaluated, because it was beyond the scope of this study.

The responses to the electric pulp tester (negative or positive) and the pain ("with pain," scores 2 or 3, or "without pain," scores 0 or 1) recorded in the 2 test groups (articaine solution and lidocaine solution groups) were compared by using the χ^2 test. Potential differences in age between the 2 groups were analyzed with the Kruskal-Wallis test. The likelihood ratio test was used to compare the distributions of types of teeth with irreversible pulpitis in both groups. For all performed tests, the level for significance of differences was taken as $P \leq .05$.

Results

In the present study, there were no statistically significant differences between the patients of the 2 test groups (articaine versus lidocaine solution) concerning gender distribution (articaine group, 50% female; lidocaine group, 70% female; $P = .20$), age (average age: articaine group, 29.9 years; lidocaine group, 34.1 years; $P = .43$), and the types of teeth with irreversible pulpitis ($P = .39$) (Table 1).

All 40 patients (100%) reported subjective lip anesthesia 10 minutes after the IAN block. Before the pulpectomy procedure, 13 patients (65%) of the articaine group and 14 patients (70%) of the lidocaine group exhibited pulpal anesthesia (Fig. 1), ie, a negative response to electrical stimuli generated with an electric pulp tester. However, this slight difference between the 2 experimental groups was not statistically significant ($P = .74$) (Fig. 1). During the pulpectomy, 7 patients of the articaine group (35%) and 11 patients of the lidocaine group (55%) reported pain (pain scores 2 and 3). Again, this difference was not statistically significant ($P = .20$) (Fig. 2).

Discussion

In our study there were no significant differences between the patients of the 2 test groups (articaine versus lidocaine solution) regarding their gender, age, and type of posterior tooth with irreversible pulpitis (Table 1). Consequently, any potential effects of these parameters can be minimized or even neglected, and the results obtained with both anesthetic solutions can be directly compared.

Our study demonstrated that although both local anesthetic solutions (4% articaine with 1:100,000 epinephrine and 2% lidocaine with

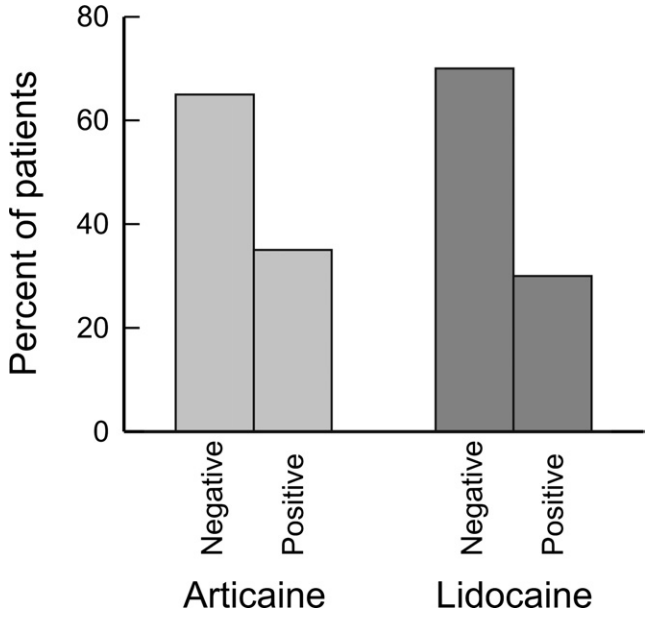

Figure 1. Bar graph of responses to the pulp tester (percent) after the respective IAN block solutions (4% articaine with 1:100,000 epinephrine and 2% lidocaine with 1:100,000 epinephrine).