Anesthetic Success of an Inferior Alveolar Nerve Block and Supplemental Articaine Buccal Infiltration for Molars and Premolars in Patients with Symptomatic Irreversible Pulpitis

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Abstract

Introduction: The purpose of this retrospective study was to determine the anesthetic success of the inferior alveolar nerve (IAN) block and supplemental articaine buccal infiltration after a failed IAN block, in first and second molars and premolars in patients presenting with symptomatic irreversible pulpitis. Methods: As part of 6 studies, 375 emergency patients presenting with symptomatic irreversible pulpitis received 2% lidocaine with 1:100,000 epinephrine via an IAN block. After profound lip numbness, endodontic access and instrumentation were initiated. If the patient felt moderate to severe pain, a supplemental buccal infiltration of a cartridge of 4% articaine with 1:100,000 epinephrine was administered (204 patients), and endodontic treatment continued. Success was defined as the ability to access and instrument the tooth without pain (visual analogue scale rating of 0) or mild pain (visual analogue scale rating less than or equal to 54 mm). Results: IAN block success was 28% for the first molars, 25% for the second molars, and 39% for the premolars. There were no significant differences when comparing molars with premolars. For the supplemental articaine buccal infiltration, success was 42% for the first molars, 48% for the second molars, and 73% for the premolars. There were no significant differences when comparing the molars, but there was a significant difference when comparing the premolars with the molars. Conclusions: For patients presenting with symptomatic irreversible pulpitis, the success rates for the IAN block and supplemental buccal infiltration of articaine of the molars and premolars would not be high enough to ensure profound pulpal anesthesia. (J Endod 2016;42:390–392)

Key Words

Anesthetic success, articaine, buccal infiltration, inferior alveolar nerve block, irreversible pulpitis, lidocaine, mandibular anesthesia

There have been more than 80 clinical studies evaluating anesthetic success rates of the inferior alveolar nerve (IAN) block in patients presenting with irreversible pulpitis (nlm.nih.gov, Pub Med, irreversible pulpitis). Most of these studies have combined the posterior teeth into a common classification. Anesthetic success of the molars and premolars in a larger cohort of studies has not been reported. In addition, other studies (1–5) have addressed a supplemental articaine buccal infiltration after failed IAN blocks in posterior teeth but not specifically in molars and premolars.

The purpose of this retrospective study was to determine the anesthetic success of the IAN block and supplemental articaine buccal infiltration after a failed IAN block in first and second molars and premolars in patients presenting with symptomatic irreversible pulpitis.

Materials and Methods

Three hundred seventy-five emergency patients presenting with symptomatic irreversible pulpitis were studied (1–6). The patients were in good health as determined by a written health history and oral questioning. Exclusion criteria were as follows: younger than 18 years of age, allergies to local anesthetics or sulfites, pregnancy, history of significant medical conditions (American Society of Anesthesiologists class II or higher), taking any medications (over-the-counter pain relieving medications, narcotics, sedatives, antianxiety or antidepressant medications) that may affect pain assessment, active sites of pathosis in area of injection, and inability to give informed consent. The patients were part of 6 anesthetic studies (1–6) conducted at The Ohio State University. The Ohio State University Human Subjects Committee approved each study, and informed consent was obtained from each patient.

Each patient had a vital mandibular posterior tooth, was actively experiencing spontaneous moderate to severe pain at the emergency appointment, and had a prolonged response to cold testing with Endo-ice (1,1,1,2 tetrafluoroethane; Hygenic Corp, Akron, OH). Patients with no or mild pain, no response to cold testing, periradicular pathosis (other than a widened periodontal ligament), or no vital coronal pulpal tissue on access were excluded from the study. Therefore, each patient had a tooth that fulfilled the criteria for a clinical diagnosis of symptomatic irreversible pulpitis.

A standard IAN block (7) was administered to the 375 patients by using a 27-gauge, 1½-inch needle (Monoject; Sherwood Services, Mansfield, MA). A 1-cartridge volume of 2% lidocaine with 1:100,000 epinephrine was administered to 274 patients, and a 2-cartridge volume of 2% lidocaine with 1:100,000 epinephrine was administered to 101 patients. For both volumes, standard anesthetic cartridges of 2% lidocaine with 1:100,000 epinephrine were used. All anesthetic solution cartridges were checked to ensure that expiration dates were acceptable. Second-year endodontic residents
performed all the injections and were experienced in IAN block injections and emergency endodontic procedures.

To be included in the data analysis, all patients were required to have profound lip numbness after the IAN block in the studies (1–6). The teeth were isolated with a rubber dam, and access was performed. Patients were instructed to definitively rate any pain felt during the endodontic procedure. If the patient felt pain, the treatment was immediately stopped, and the patient rated their discomfort by using a 170-mm Helt-Parker visual analogue scale (VAS) (8). The VAS was divided into 4 categories as described previously (3–5).

If the patient recorded no pain or mild pain (0–54 mm on the VAS), treatment continued. If the patient experienced moderate or severe pain (VAS rating equal to or greater than 55 mm, 221 patients), the rubber dam was removed, and a supplemental buccal infiltration of a cartridge of 4% articaine with 1:100,000 epinephrine (Septocaine; Septodont, New Castle, DE) was administered buccal to the tooth requiring emergency treatment (1–5). Anesthetic was deposited at the approximate level of the root apex or apices. After waiting 5 minutes for the infiltration to take effect, the rubber dam was replaced, and endodontic access was continued. If the patient reported no or mild pain, the treatment was resumed. However, if moderate to severe pain was experienced, additional supplemental intraosseous anesthesia was given to complete the procedure comfortably (2–5).

The success of the IAN block and supplemental buccal infiltration was defined as the ability to access and instrument the tooth without pain (VAS rating of 0) or mild pain (VAS rating less than or equal to 54 mm).

Anesthetic success data (IAN block and buccal infiltration) were analyzed by using the Cochran-Mantel-Haenszel test (repeated tests of independence) that allowed control of the potential confounders of anesthetic volume, study, and gender. Confidence intervals for tooth type were also calculated. Comparisons were considered significant if \( P < .05 \).

**Results**

A total of 375 adult patients, 167 men and 208 women, ranging in age from 18 to 65 with a mean age of 33 years participated in this study. Percentages of patients who experienced anesthetic success with the IAN block are presented in Table 1. Success was 28% for the first molar, 25% for the second molar, and 39% for the premolars. There were no significant differences among tooth types: first molar to second molar (\( P = .6761 \)), second molar to premolars (\( P = .2067 \)), or first molar to premolars (\( P = .4368 \)).

A total of 221 adult patients, 97 men and 124 women, ranging in age from 18 to 65 with a mean age of 33 years participated in the portion of the study that used the articaine infiltration after a failed IAN block. Percentages of patients who experienced anesthetic success are presented in Table 2. Success was 42% for the first molar, 48% for the second molar, and 73% for the premolars. There was no significant difference comparing first molar with second molar (\( P = .3450 \)) and first molar with premolars (\( P = .0132 \)).

**Discussion**

Molars and premolars were not significantly different regarding success of the IAN block (Table 1). In asymptomatic subjects, success rates (no response to 2 consecutive electrical pulp testing readings of 80) after an IAN block were 65% for second molars, 51% for first molars, and 58%–60% for premolars (9). The lower success rates in patients presenting with symptomatic irreversible pulpsitis are probably related to the following: patients in pain are often apprehensive, which lowers their pain threshold; inflammatory conditions cause chemokines and cytokines to lower the excitability thresholds of some nociceptors (10); and tetrodotoxin-resistant class of sodium channels is resistant to the action of local anesthetics (11). Overall, the success rates of 25%–39% for the molars and premolars would not be high enough to ensure profound pulpal anesthesia.

Although there was no significant difference regarding success of the buccal articaine infiltration when comparing molars, there was a significant difference when comparing molars with the premolars (Table 2). In asymptomatic subjects, a primary articaine infiltration of 1.8 mL of a 4% articaine formulation of the first molar ranged from 50% to 87% (64% by Kanaa et al (12), 87% by Robertson et al (13), 54% by Jung et al (14), 64%–70% by Corbett (15), 64%–69% by Pabst et al (16), 59% by McIntyre et al (17), 50% by Martin et al (18), 73% by Currie et al (19), 52% by Kwon et al (20), 55% by Nydegger et al (21), and 65% by Shurtz et al (22)). The addition of a buccal infiltration of 4% articaine with 1:100,000 epinephrine to an IAN block in asymptomatic subjects increased success rates to 88% (23, 24). Obviously, success rates are lower in patients with symptomatic irreversible pulpsitis because of the factors discussed previously. The higher success rates in the premolars are related to the higher success rates in these teeth with buccal infiltration. A success rate of 80%–87% was found for a primary mandibular, buccal premolar infiltration of a cartridge of 4% articaine with 1:100,000 epinephrine in asymptomatic subjects (25). These success rates are higher than in the first molar and are probably related to anesthetic solution access to the mental foramen when a premolar infiltration is used. Regardless, the success rates were not high enough to ensure complete pulpal anesthesia. In the current study of patients with symptomatic irreversible pulpsitis, although the articaine infiltration success rate (73%) was higher than the molars (42%–48%), the success rate was still not high enough to ensure complete anesthesia. Therefore, practitioners should consider additional supplemental techniques, such as intraosseous or intraligamental injections, to achieve pulpal anesthesia when an IAN block and buccal infiltration of articaine fail to provide pulpal anesthesia for patients with irreversible pulpsitis (9).

**Table 1. Percentages of Patients Who Experienced Anesthetic Success with the IAN Block**

<table>
<thead>
<tr>
<th>Tooth Type</th>
<th>Anesthetic Success (%)</th>
<th>LCB</th>
<th>UCB</th>
</tr>
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<tbody>
<tr>
<td>First molars</td>
<td>28 (49/176)</td>
<td>21</td>
<td>35</td>
</tr>
<tr>
<td>Second molars</td>
<td>25 (36/142)</td>
<td>18</td>
<td>33</td>
</tr>
<tr>
<td>Premolars</td>
<td>39 (22/57)</td>
<td>26</td>
<td>51</td>
</tr>
</tbody>
</table>

LCB, lower confidence boundary; UCB, upper confidence boundary.

\( n = 375 \)

*There were no significant differences when comparing tooth type (first molar with second molar, \( P = .6761 \); second molar with premolars, \( P = .2067 \); first molar with premolars, \( P = .4368 \)).

**Table 2. Percentages of Patients Who Experienced Anesthetic Success with Articaine Buccal Infiltration after Failed IAN Block**

<table>
<thead>
<tr>
<th>Tooth Type</th>
<th>Anesthetic success (%)</th>
<th>LCB</th>
<th>UCB</th>
</tr>
</thead>
<tbody>
<tr>
<td>First molars</td>
<td>42 (39/93)</td>
<td>32</td>
<td>52</td>
</tr>
<tr>
<td>Second molars</td>
<td>48 (36/75)</td>
<td>36</td>
<td>60</td>
</tr>
<tr>
<td>Premolars</td>
<td>73 (19/36)</td>
<td>52</td>
<td>88</td>
</tr>
</tbody>
</table>

LCB, lower confidence boundary; UCB, upper confidence boundary.

\( n = 221 \)

*There were no significant differences when comparing first molar with second molar (\( P = .3450 \)).

There was a significant difference when comparing second molar with premolars (\( P = .0411 \)) and first molar with premolars (\( P = .0132 \)).
In conclusion, for patients presenting with symptomatic irreversible pulpitis, the success rate for the IAN block of the molars and premolars would not be high enough to ensure profound pulpal anesthesia. Although the supplemental buccal infiltration of articaine was statistically better for the premolars than the molars, the moderate success rate was not high enough to ensure profound pulpal anesthesia.

Acknowledgments

The authors deny any conflicts of interest related to this study.

References