Does the Combination of 3% Mepivacaine Plain Plus 2% Lidocaine with Epinephrine Improve Anesthesia and Reduce the Pain of Anesthetic Injection for the Inferior Alveolar Nerve Block? A Prospective, Randomized, Double-blind Study

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Abstract

Introduction: In theory, using 3% mepivacaine initially for an inferior alveolar nerve (IAN) block would decrease the pain of injection, provide faster onset, and increase anesthetic success. The purpose of this prospective, randomized, double-blind study was to compare the degree of pulpal anesthesia obtained with a combination of 3% mepivacaine/2% lidocaine (1:100,000 epinephrine) versus a combination of 2% lidocaine (1:100,000 epinephrine)/2% lidocaine (1:100,000 epinephrine) in IAN blocks. Injection pain was also studied. **Methods:** One hundred asymptomatic subjects were randomly given a combination of a 1-cartridge volume of 3% mepivacaine plus a 1-cartridge volume of 2% lidocaine with 1:100,000 epinephrine and a combination of a 1-cartridge volume of 2% lidocaine with 1:100,000 epinephrine plus a 1-cartridge volume of 2% lidocaine with 1:100,000 epinephrine for the IAN block at 2 separate appointments. Subjects rated the pain of injection. The molars, premolars, and incisors were tested with an electric pulp tester in 4-minute cycles for 60 minutes. Anesthetic success was defined as the subject achieving 2 consecutive 80 readings within 15 minutes after completion of the IAN blocks and sustaining the 80 reading for 60 minutes. **Results:** Success was not significantly different ($P > .05$) between the 2 combinations. No statistical differences in injection pain or onset times were found. **Conclusions:** The combination of 3% mepivacaine plus 2% lidocaine with 1:100,000 epinephrine was equivalent to the combination of 2 cartridges of 2% lidocaine with 1:100,000 epinephrine in terms of injection pain, onset time, and pulpal anesthetic success for the IAN block. *(J Endod 2014;40:1287–1292)*

Key Words

Inferior alveolar nerve block, injection pain, lidocaine with epinephrine, 3% mepivacaine

The inferior alveolar nerve (IAN) block does not always result in successful pulpal anesthesia (1). Failure rates of 17%–58% have been reported in experimental studies (1). Therefore, it would be advantageous to improve the success rate of the IAN block.

Some clinicians initially administer 3% mepivacaine plain and then add 2% lidocaine with 1:100,000 epinephrine for IAN blocks (1). The rationale is that 3% mepivacaine has a higher pH because it does not contain epinephrine and has more anesthetic molecules than 2% lidocaine because of its higher concentration (1). In theory, using 3% mepivacaine initially would decrease the pain of injection, provide a quicker onset of anesthesia, increase anesthetic success, and possibly potentiate the effect of giving a second cartridge of 2% lidocaine with epinephrine for IAN blocks.

No objective study has combined 3% mepivacaine and 2% lidocaine with 1:100,000 epinephrine for IAN blocks. Therefore, the purpose of this prospective, randomized, double-blind study was to compare the degree of pulpal anesthesia obtained with a combination of 3% mepivacaine/2% lidocaine with 1:100,000 epinephrine versus a combination of 2% lidocaine with 1:100,000 epinephrine/2% lidocaine with 1:100,000 epinephrine in IAN blocks in asymptomatic subjects. Injection pain of the IAN blocks was also studied.

Materials and Methods

One hundred adult subjects participated in this study. The subjects were in good health as determined by a written health history and oral questioning. Exclusion criteria were as follows: younger than 18 or older than 65 years of age, American Society of Anesthesiologists classification of II or greater, allergy to local anesthetics or sulfites, taking any medications (analgesics, alcohol, antidepressant or antianxiety medications) that would alter perception of pain or metabolism of anesthetics within the last 48 hours, and inability to give informed consent. Women were questioned regarding pregnancy and were not allowed to participate if pregnant, suspected a pregnancy, trying to

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become pregnant, or lactating. The Human Subjects Review Committee approved the study, and written informed consent was obtained from each subject.

The 100 blinded subjects randomly received 2 combination sets of IAN blocks, either a cartridge of 3% mepivacaine (Carbocaine; Dentsply Pharmaceutical, York, PA) followed by a cartridge of 2% lidocaine with 1:100,000 epinephrine (Xylocaine; Dentsply Pharmaceutical) or a cartridge of 2% lidocaine with 1:100,000 epinephrine followed by a second cartridge of 2% lidocaine with 1:100,000 epinephrine at 2 separate appointments spaced at least 1 week apart in a crossover design. With the crossover design, there were 200 combination sets of IAN blocks administered, and each subject served as his or her own control. An equal number of combination sets of IAN blocks were administered on the right side and the left side. The same side randomly chosen for the first set of injections was used again for the second set of injections. The test teeth chosen for the experiment were the first and second molars, first and second premolars, and central and lateral incisors. The contralateral canine was used as the unanesthetized control to ensure that the pulp tester was operating properly and that the subject was responding appropriately during each experimental portion of the study. Clinical examinations were done before subject inclusion to ensure that all teeth were free of caries, large restorations, and periodontal disease; no patients had a history of trauma or sensitivity.

Before the experiment, the 2 combination sets of IAN blocks were randomly assigned 6-digit numbers from a random number table. Each subject was randomly assigned to 1 of the 2 sets of IAN blocks to determine which set would be administered at each appointment. To blind the anesthetic solutions, the labels were removed from the appropriate cartridges, and they were then covered with a partial label, and the 6-digit number was written on the label. The colors of the cartridge tips and rubber stoppers were identical for both types of anesthetic formulations. All anesthetic cartridges were checked to ensure that the anesthetic solution had not expired. Only the random numbers were recorded on the data collection sheets to help blind the experiment.

At the beginning of each appointment and before any injections were given, the experimental teeth and control contralateral canine were tested 3 times with the electric pulp tester (Kerr, Analytic Technology Corp, Redmond, WA) to record baseline vitality. After the tooth to be tested was isolated with cotton rolls and dried with gauze, toothpaste (Crest Cavity Protection; Procter & Gamble, Cincinnati, OH) was applied to the probe tip, which was placed halfway between the gingival margin and the occlusal or incisal edge of the tooth. The current rate was set at 25 seconds to increase from no output (0) to the maximum output (80). The number associated with the initial sensation was recorded. Trained research personnel performed all preinjection and postinjection tests. The trained research assistants were dental or hygiene students specifically trained in conducting this clinical trial.

Before the IAN block, each subject was informed of the pain rating for injection pain and shown the Heft-Parker visual analog scale (VAS) (2). The VAS was a 170-mm line with various descriptive terms. Immediately after each IAN block, each subject rated the pain for needle insertion, needle placement, and solution deposition on the VAS by placing a mark on the scale where it best described their pain level. To interpret the data, the VAS was divided into the following 4 categories. No pain corresponded to 0 mm on the scale. Mild pain was defined as greater than 0 mm and less than or equal to 54 mm. Mild pain included the descriptors of "faint," "weak," and "mild" pain. Moderate pain was defined as greater than 54 mm and less than 114 mm and included the descriptor of "moderate" pain. Severe pain was defined as equal to or greater than 114 mm. Severe pain included the descriptors of "strong," "intense," and "maximum possible" pain.

Topical anesthetic gel (0.2 mL) (20% benzocaine; Benco Dental, Pittston, PA) was passively placed at the dried IAN block injection site for 60 seconds by using a cotton tip applicator. A standard IAN block (3) was administered with a 27-gauge 1½-inch needle (Monoject; Sherwood Medical, St Louis, MO) attached to a standard aspirating syringe. The syringe was loaded with 1 blinded cartridge of either 3% mepivacaine or 2% lidocaine with 1:100,000 epinephrine. The needle was gently inserted 2–3 mm through the mucosa (needle insertion) and was then advanced to the target site (placement) without depositing any anesthetic solution. After negative aspiration, the anesthetic was deposited during a 90-second time period (solution deposition). The subject rated the pain from the first IAN block on a VAS.

One minute after the first IAN block, a second cartridge of anesthetic solution (2% lidocaine with 1:100,000 epinephrine) was administered as described above. The subject then rated the pain of the second IAN block on a second VAS. All IAN blocks were given by the senior author (E.L.).

During the first 15 minutes of electric pulp testing, each subject was asked if his or her lip was numb every minute. If profound lip numbness was not recorded within 15 minutes of the combination injections, the block was considered unsuccessful; the subject was then reappointed. Six subjects were reappointed because they did not have lip numbness at 15 minutes after injection (2 in the mepivacaine/lidocaine combination and 4 in the lidocaine/lidocaine combination). All of these subjects achieved lip numbness at the second appointment.

At 1 minute after the second IAN block, the first and second molars were tested with the electric pulp tester. At 2 minutes, the first and second premolars were tested. At 3 minutes, the lateral and central incisors were tested. At 4 minutes, the control canine was tested. This cycle of testing was repeated every 4 minutes. At every third cycle the control tooth, the contralateral canine, was tested by an inactivated pulp tester to test the reliability of the subject. If the subject responded positively to an inactivated pulp tester, then she/he was not reliable and was not used in the study. One subject was excluded and replaced with another subject. All testing was stopped at 60 minutes after injection.

No response from the subject at the maximum output (80 reading) of the pulp tester was used as the criterion for pulpal anesthesia. Anesthesia was considered successful when the first of 2 consecutive 80 readings was obtained by 15 minutes of the completion of the 2 sets of IAN blocks and the 80 reading was continuously sustained for 60 minutes. We would want the patient anesthetized by 15 minutes and have pulpal anesthesia for 60 minutes. Onset of pulpal anesthesia was recorded at the time of the first of 2 consecutive 80 readings.

The pH of each anesthetic formulation was randomly tested by using an Orion Star AIII pH meter (Thermo Scientific, Beverly, MA). The pH tester was calibrated with pH buffers (NIST Traceable Solution; Oakton, Vernon Hills, IL) before testing.

Comparisons between the 2 combination sets of anesthetic formulations for anesthetic success, anesthesia onset, and incidence of pulpal anesthesia (percentage of 80 readings across time) were analyzed nonparametrically by using exact McNemar tests with P values adjusted by using the step-down Bonferroni method of Holm. Between-anesthetic formulation differences in pain ratings for needle insertion, needle placement, and solution deposition were analyzed by using multiple Wilcoxon matched-pairs, signed rank tests with P values adjusted by using the step-down Bonferroni method of Holm. Comparisons were considered significant at $P < .05$.

With a nondirectional alpha risk of 0.05 and assuming a total proportion of discordant pairs of 0.5, a sample size of 100 subjects was required to demonstrate a difference of $\pm$ 20 percentage points in anesthetic success with a power of 0.82.