Anesthetic Efficacy of Lidocaine/Meperidine for Inferior Alveolar Nerve Blocks in Patients with Irreversible Pulpitis

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Abstract

The purpose of this prospective, randomized, single-blind study was to compare the anesthetic efficacy of lidocaine with epinephrine to lidocaine plus meperidine with epinephrine for inferior alveolar nerve blocks (IAN) in patients with mandibular posterior teeth experiencing irreversible pulpitis. Forty-eight emergency patients diagnosed with irreversible pulpitis of a mandibular posterior tooth randomly received, in a single-blind manner, 36 mg of lidocaine with 18 μg epinephrine or 36 mg of lidocaine with 18 μg of epinephrine plus 36 mg meperidine with 18 μg epinephrine, using a conventional inferior alveolar nerve block. Endodontic access was begun 15 minutes after solution deposition, and all patients were required to have profound lip numbness. Success was defined as no or mild pain (visual analog scale recordings) upon endodontic access or initial instrumentation. The success rate for the inferior alveolar nerve block using the lidocaine solution was 26%, and for the lidocaine/meperidine solution, the success rate was 12%. There was no significant difference ($p = 0.28$) between the two solutions. In conclusion, for mandibular posterior teeth with irreversible pulpitis, the addition of 36 mg of meperidine to a lidocaine solution administered in a conventional IAN block did not improve the success rate over a standard lidocaine solution. *(J Endod 2007;33:7–10)*

Key Words

Inferior alveolar nerve block, irreversible pulpitis, lidocaine, meperidine

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Clinical studies in endodontics (1–6), in patients presenting with irreversible pulpitis, have found failure with the inferior alveolar nerve (IAN) block occurring between 44% and 81% of the time. Therefore, it would be advantageous to improve the success rate of the IAN block in endodontics.

Meperidine was first introduced in 1939 as an analgesic, sedative, and antispasmodic agent (7). It is also known as pethidine or Demerol. Meperidine is a phenylpiperidine derivative of the opioids (8, 9). The molecular weight and pKa of meperidine are closer to those of lidocaine than to other opioids (8).

Clinically, meperidine has local anesthetic activity. A number of clinical and experimental studies (10–22) have shown that meperidine induces spinal anesthesia and blocks action potentials, providing segmental and sensory blocks comparable in effect to lidocaine. In medicine, it has been administered intrathecally (8, 10, 14, 16, 18), spinally (13, 20), and as a saddle block (11), as well as locally for intravenous regional anesthesia (21), block (15), and infiltration (22) for the effects of analgesia, anesthesia, or both.

The exact mechanism of meperidine's local anesthetic activity is unknown. It is possible that meperidine acts peripherally through opioid specific receptors. However, Pang and co-authors (23) found meperidine was effective in reducing propofol injection pain; this result was not reversible by the addition of naloxone. Jaffe and Rowe (24) found that meperidine blocked conduction of myelinated and unmyelinated axons, and this was not reversed by naloxone. These two studies (23, 24) would suggest a nonopioid mechanism of local anesthetic activity. Hunter and Frank (25) felt the effect of meperidine was because of two mechanisms, a nonspecific local anesthetic effect and an opiate receptor mediated effect. Brau et al. (9) demonstrated that meperidine has a blocking effect on sodium channels in a similar concentration as lidocaine but did not compete for the same binding site as traditional local anesthetics.

Armstrong et al. (21) demonstrated an enhanced effect when meperidine was added to a local anesthetic for intravenous regional anesthesia. They found meperidine increased the speed of onset and extent of sensory and motor blockade and subjectively improved the quality of the block. Maurette et al. (20) also found a synergistic effect when meperidine was used in combination with a local anesthetic.

No study has investigated the efficacy of a combination lidocaine/meperidine anesthetic solution in patients with irreversible pulpitis. Therefore, the purpose of this prospective, randomized, single-blind study was to compare the anesthetic efficacy of 36 mg of lidocaine with 18 μg of epinephrine to 36 mg of lidocaine with 18 μg of epinephrine plus 36 mg of meperidine with 18 μg of epinephrine for inferior alveolar nerve blocks in patients, with mandibular posterior teeth, experiencing irreversible pulpitis.

Materials and Methods

Initially, 50 adult patients participated in this study. All were emergency patients of the College of Dentistry and were in good health as determined by a health history and oral questioning. The Ohio State University Human Subjects Review Committee approved the study, and written informed consent was obtained from each patient.

To qualify for the study, each patient had a vital mandibular posterior tooth (molar or premolar), was actively experiencing pain, and had a prolonged response to cold testing with Endo-ice (1,1,1,2 tetrafluoroethane; Hygenic Corp., Akron, OH). Patients with no response to cold testing, periradicular pathosis (other than a widened periodontal ligament), or no vital coronal pulp tissue upon access were excluded from the

study. Therefore, each patient had a tooth that fulfilled the criteria for a clinical diagnosis of irreversible pulpitis.

Each patient rated his or her initial pain on a Heft Parker visual analogue scale (VAS) (26). The VAS scale was divided into four categories. No pain corresponded to 0 mm. 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. Severe pain was defined as equal to or greater than 114 mm. Severe pain included the descriptors of strong, intense, and maximum possible.

The 50 patients randomly received 1.8 ml of 36 mg of lidocaine (Xylocaine, Abbott Laboratories, North Chicago, IL) with 18 μg of epinephrine (Abbott Laboratories) or 3.6 ml of 36 mg of lidocaine with 18 μg of epinephrine plus 36 mg meperidine (Abbott Laboratories) with 18 μg of epinephrine using a conventional inferior alveolar nerve block. Each patient was randomly assigned a five-digit random number to determine which anesthetic solution was administered. The senior author (J.B.) administered all injections.

Under sterile conditions, the lidocaine and lidocaine/meperidine solutions were prepared each day of the appointment. For the lidocaine solution, 0.9 ml of solution was drawn from a vial of 4% lidocaine (40 mg/ml Xylocaine, Abbott Laboratories) using a sterile 3-ml Luer-Lok syringe (Becton Dickinson & Co., Franklin Lakes, NJ). Nine-tenths milliliter of sterile saline was drawn from a 10-ml vial (0.9% bacteriostatic sodium chloride, Abbott Laboratories) using a sterile 3-ml Luer-lok syringe. The two solutions of lidocaine and saline were deposited into a sterile 5-ml Luer-lok syringe and mixed by inverting the syringe 10 times. Eighteen micrograms of epinephrine was withdrawn from a 1-ml ampule of 1:1,000 epinephrine (1 mg/ml, Abbott Laboratories) using an Oxford Benchmate Pipette (Sherwood Medical, St. Louis, MO). The epinephrine was then added to the 5-ml syringe containing the lidocaine solution. The result was a solution of 36 mg of lidocaine with 18 μg of epinephrine in 1.8 ml.

The combination lidocaine/meperidine solution was prepared as follows. For the lidocaine component of the solution, the same procedure was followed as outlined above. For the meperidine component of the solution, 0.72 ml of meperidine was drawn from a vial of 5% meperidine (50 mg/mL, Abbott Laboratories) using a sterile 3-ml Luer-Lok syringe. A 1.08-ml amount of sterile saline was drawn into a sterile syringe from a 10-ml vial of 0.9% bacteriostatic sodium chloride. The meperidine and saline solution were added to a sterile 5-ml Luer-Lok syringe and mixed by inverting the syringe. The lidocaine component was added to the same syringe and mixed. Eighteen micrograms of epinephrine was withdrawn from a 1-ml ampule of 1:1,000 epinephrine using an Oxford Benchmate Pipette, and this was added to the 5-ml syringe. The result was a solution of 36 mg of lidocaine plus 36 mg of meperidine with 36 μg of epinephrine in 3.6 ml. The pH for the lidocaine solution and the lidocaine/meperidine solution was 6.6 and 6.5, respectively.

The 36-mg dose of meperidine was chosen because Reuben and co-authors (27), in a dose-response study of regional anesthesia, showed that the incidence of side effects was increased when the dose was above 40 mg.

The appropriate five-digit random number was placed on a label, which was affixed to the outside of the Luer-Lok syringe. Only the random number was used on the data collection sheets to further blind the experiment.

Topical anesthetic gel (20% benzocaine, Patterson Dental Supply, Inc., St. Paul, MN) was passively placed at the IAN injection site for 60 seconds using a cotton tip applicator. A standard inferior alveolar nerve block (28) was administered with a 27-gauge 1.5-inch needle (Monoject; Sherwood Services, Mansfield, MA) using the appropriate 5-ml syringe equipped with an aspirating handle (Becton-Dickinson & Co., Rutherford, NJ). After initial needle penetration, the needle was advanced toward the target site over a period of 10 seconds while expressing 0.2 ml of anesthetic solution. After gentle contact with bone, the needle was withdrawn 1 mm, aspiration was performed, and the remaining anesthetic solution (1.8 or 3.6 ml) was deposited over a 2-minute time period regardless of anesthetic volume. A long buccal nerve injection was also given, using a quarter of a cartridge of 2% lidocaine with 1:100,000 epinephrine, administered with a separate aspirating syringe.

At 15 min postinjection, the patient was questioned regarding lip numbness. If profound lip numbness was not recorded, the block was considered missed, and the patient was eliminated from the study.

At 15 min postinjection, 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 using the Heft-Parker visual analog scale (26). The extent of access achieved when the patient felt pain was recorded as within dentin, entering the pulp chamber, or initial file placement. The success of the IAN blocks was defined as the ability to access and instrument the tooth without pain (VAS score of zero) or mild pain (VAS rating less than or equal to 54 mm).

Subjects were asked to respond if they felt sedated or drowsy at the conclusion of the appointment.

Comparisons between the lidocaine and lidocaine/meperidine solutions for age and initial pain scores were analyzed using the Mann-Whitney-Wilcoxon test. Gender differences were analyzed using the chi-square test. Anesthetic success and differences in tooth type were analyzed using Fisher's exact test. With a two-sided alpha risk of 0.05 and a power of 80%, a sample size of 23 subjects per group was required to detect a difference of $\pm$25% in anesthetic success. Comparisons were considered significant if $p < 0.05$.

Results

The age, gender, and initial pain of the patients are presented in Table 1. There were no significant differences ($p > 0.05$) between the two groups. The distribution of the teeth is outlined in Table 2. There were no significant differences ($p > 0.05$) between the two groups. Two patients (one in each group) did not have profound lip numbness at 15 minutes and were not included in the data analysis. The final number of patients analyzed was 48 and 100% of the subjects used for data analysis had subjective lip anesthesia with either the lidocaine or lidocaine/meperidine solutions.

Anesthetic success is presented in Table 3. Discomfort ratings for patients experiencing greater than mild pain (anesthetic failure) upon access with the lidocaine and lidocaine/meperidine solutions are summarized in Table 4.

TABLE 1. Initial values for the lidocaine and lidocaine/meperidine groups

Value	Lidocaine	Lidocaine/meperidine	p value*
Age†	34 years ± 13 Range 21–53 years	29 years ± 11 Range 20–48 years	1.00
Gender	15 Females 8 Males	13 Females 12 Males	0.35
Initial pain‡	104 ± 36	103 ± 31	0.95

*There were no significant differences ($p > 0.05$) between the two groups.

†Mean ± SD.

‡Mean ± SD, Heft Parker VAS ratings.