The Effect of Preoperative Acetaminophen or a Combination of Acetaminophen and Ibuprofen on the Success of Inferior Alveolar Nerve Block for Teeth with Irreversible Pulpitis

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Abstract

This study compared preoperative administration of acetaminophen or a combination of acetaminophen and ibuprofen versus placebo for potential increased effectiveness of inferior alveolar nerve (IAN) block anesthesia. There were 40 patients with irreversible pulpitis randomly assigned to a drug or placebo group. Thirty minutes after ingestion of medication, an IAN block was administered. A cold test was done 15 minutes after the block, and if the patients had no sensitivity, endodontic therapy was initiated. If the patient had no pain on access, the IAN was recorded as successful. If the patient had sensitivity to cold or to the access procedure, it was recorded as a failure. Overall success was 60% for all three groups. Success was 71.4% for the acetaminophen group, 75.9% for the acetaminophen and ibuprofen group, and 46.2% for the placebo group. There was no significant difference between the groups; however, there was a trend toward higher success in the medication groups. *(J Endod 2007;33:11–14)*

Key Words

Acetaminophen, anesthesia, endodontics, hyperalgesia, ibuprofen

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0099-2399/$0 - see front matter

doi:10.1016/j.joen.2006.09.005

Anesthetizing mandibular teeth with an inferior alveolar nerve (IAN) block has been regarded as one of the most technically difficult local anesthesia injections. In the absence of pulpal or periapical pathosis, IAN block provides clinically adequate anesthesia for restorative dentistry 85 to 90% of the time (1–4). However, in cases of irreversible pulpitis, the rate of success is greatly reduced; reportedly as low as 20% (5). Previous studies have cited several reasons for IAN block failures in healthy or inflamed pulps. The reasons include pulpitis anatomic differences (such as accessory innervation, bifid IAN, anatomic position of the mandibular canal), concentration of anesthetic agent, volume of anesthetic solution, patient's level of anxiety, and a patient's past history with successful anesthesia (6–13). Several published articles about local anesthetic failures in endodontics concluded that IAN blocks are technically difficult, with a success rate of 75 to 90% anesthesia for uninflamed pulps (14–17). These articles concluded that local anesthetics are less effective for inflamed pulps, with failure rates at 30 to 80%. Several researchers suggested that if pulpal inflammation can be reduced before anesthesia delivery, local anesthesia might be more successful (1–3, 14, 18).

Nonsteroidal anti-inflammatory drugs (NSAIDs) and glucocorticosteroids can diminish inflammation at different levels in the inflammatory process (19–21). NSAIDS block the cyclooxygenase enzyme in the pathway that produces prostaglandins, resulting in lower levels of inflammation-inciting prostaglandins (22, 23). Although the action of acetaminophen is unknown, it has been suggested that it interferes with inflammation by diminishing the synthesis of prostaglandins (possibly PGF2); and also alters the transmission of pain by acting directly on an unknown site in the brain (1, 2). Glucocorticosteroids can have a profound effect on inflammation by suppressing vasodilation, PMN migration, and phagocytosis (22). Glucocorticosteroids inhibit the formation of arachidonic phospholipids, thus blocking the cyclooxygenase and lipoxygenase pathways and resultant synthesis of prostaglandins and leukotrienes (1, 2, 22).

There have been multiple studies using NSAIDS preoperatively to reduce inflammation and pain (19–21). Steroids are used by some clinicians to control preoperative pain and interappointment pain and prevent flare-ups (24–29). Acetaminophen and ibuprofen remain popular analgesics, and some practitioners alternate acetaminophen and ibuprofen for interappointment and postoperative pain relief (1–3, 30).

To date there has been no published research investigating fast-acting medications to decrease hyperalgesia and achieve more predictable anesthesia. Because acetaminophen and the combination of ibuprofen and acetaminophen have successfully controlled dental pain and inflammation, they were chosen for evaluation.

The purpose of this double-blinded, randomized, prospective study was to evaluate oral preoperative administration of 1,000 mg of acetaminophen or a combination of 1000 mg of acetaminophen and 600 mg of ibuprofen versus placebo for effectiveness of IAN block for patients diagnosed with irreversible pulpitis.

TABLE 1. IAN block success determined with cold test after 15 minutes

Characteristic	Overall (n = 40)	Group		
		Aceta only (n = 14)	Aceta/ibup (n = 13)	Placebo (n = 13)
Age (mean)	36.3	38.5	36.6	33.7
Gender (%)				
Male	40.0	35.7	30.8	53.9
Female	60.0	64.3	69.2	46.2
ASA class				
I	47.5	50.0	46.2	46.2
II	52.5	50.0	53.8	53.8
Success				
Yes	80.0	78.6	76.9	84.6

Aceta, acetaminophen; ibup, ibuprofen.

Success was defined as no response to cold test.

Materials and Methods

Patient Selection and Operator

Forty adult patients with a diagnosis of irreversible pulpitis in a posterior mandibular tooth were invited to participate in this study. The number of patients (n = 40) chosen for this study was based on a power analysis, expecting that IAN block success of the medicated group would increase from 30 to 80% (range, 75–90%). All patients were 19 years old or older, in good health, and had no contraindications to taking acetaminophen, ibuprofen, or sugar placebo. The University of Alabama at Birmingham Institutional Review Board approved this study, and the written informed consent of all human subjects who participated in the experimental investigation reported or described in this manuscript was obtained after the nature of the procedure and possible discomforts and risks had been fully explained.

The diagnosis of irreversible pulpitis was confirmed by a chief complaint of spontaneous pain and cold test application causing an elevated and lingering pain response. Data collected from the patients included age, gender, ASA (American Society of Anesthesiologists) classification, blood pressure, medical history, current medications, and history of symptoms.

Medications

Medications were prepared and assigned random numbers by a university hospital pharmacist. All samples were placed in amber medicine bottles containing the premedication dispersed into four blue gelatin capsules. The gelatin capsules contained either sugar placebo, 1,000 mg of acetaminophen in the form of Extra Strength Tylenol rapid release gels, or a combination of 1,000 mg of Extra Strength Tylenol rapid release gels and 600 mg of ibuprofen in Advil liquid gels. The onset of clinical action of rapid release acetaminophen and liquid gel ibuprofen, as stated by the manufacturers, is between 15 and 30 minutes (31).

Clinical Procedure

To confirm the diagnosis of irreversible pulpitis, teeth were cold tested by spraying Green Endo Ice refrigerant spray (Hygenic Corporation, Akron, OH) on two #6 cotton pellets held by cotton pliers until crystals formed on the cotton pellets. The pellets were immediately applied to the occlusal surface of the tooth until the patient felt discomfort. A 10-level visual analog scale (VAS) was used to record a baseline level of pain from cold stimulation.

The 40 patients were each given a randomized medication, assigned by drawing a coded bottle from a box. The code number and the time of ingestion were recorded on each patient's data sheet by the primary investigator.

Thirty minutes after taking the medication, before the IAN block, the tooth was retested with the cold spray. This was to determine whether the pain or sensitivity had subsided substantially because of the medication. A second VAS was recorded to determine a reduction in the pain level from the medication. If the level decreased more than two increment numbers from baseline, the patient was excluded from the study. None of the patients were excused from the study. All standard IAN block injections were administered by the principle investigator.

IAN block injection was administered using 3.6 ml of 2% lidocaine with 1:100,000 epinephrine, and the time immediately after the second injection was recorded on the data sheet. Fifteen minutes after the local anesthetic injection, lip signs were confirmed and the tooth was again tested with the cold spray; three possible outcomes were recorded. First, if the patient felt pain or discomfort, the test was recorded as a failure and supplemental anesthesia was provided. Second, if the patient did not feel pain to the cold spray, a rubber dam was placed and a standard endodontic access was begun with a 557 bur, using water spray coolant. If the patient felt pain during access, the outcome was recorded as a failure and supplemental anesthesia was administered. Lastly, if access and subsequent treatment were rendered without pain, the IAN block was recorded as a success.

The premedication codes were sent directly to the statistician by the pharmacist. Comparisons between failure and success of the IAN block and premedication were analyzed using a Mantel-Haenszel χ^2 test with a SAS v9.1 program. A multivariate logistic regression analysis to adjust for age, gender, and ASA classification was also performed. Comparisons were considered significant at $p < 0.05$.

Results

Forty patients, 24 women and 16 men, aged 19 to 72 years old with an average age of 36 years, participated. Fourteen patients took 1,000 mg of acetaminophen only, 13 patients took a combination of 1,000 mg of acetaminophen and 600 mg of ibuprofen, and 13 patients took placebo. All patients had lip numbness at 15 minutes after IAN block.

Of the 14 who took acetaminophen, 11 patients (78.6%) had no pain to the cold test 15 minutes after the local anesthetic was administered. Ten of these 11 patients (90.0%) experienced no pain during access.

Of the 13 patients who took the combination of acetaminophen and ibuprofen, 10 patients (76.9%) had no pain to the cold test 15 minutes after the local anesthetic was administered. These same 10 patients (100%) experienced no pain on access.

Of the 13 patients who received the placebo, 12 patients (84.6%) experienced no pain to the cold test 15 minutes after the local anesthetic was administered. However, only 6 of these 12 patients (50%) had no pain on access. Although there was no statistically significant difference with any of these comparisons, there was a trend with less success in the placebo group (Tables 1 and 2). The multivariate logistical regression analysis adjusted for age, gender, and ASA classification showed no significance difference (Tables 3 and 4).

TABLE 2. Multivariate analysis

Group	Success		
	p-value	Odds ratio (OR)	Confidence interval (CI)
Aceta only	0.7932	0.63	(0.07-5.41)
Aceta/ibup	0.7972	0.63	(0.07-5.34)
Placebo	Ref		

Aceta, acetaminophen; ibup, ibuprofen.

Success was defined as no response to cold test.

Data were for age, gender, and ASA classification.

TABLE 3. IAN block success

Characteristic	Overall (n = 40)	Group		
		Acetaminophen only (n = 14)	Acetaminophen/ibuprofen (n = 13)	Placebo (n = 13)
Age (mean)	36.3	38.5	36.6	33.7
Gender (%)				
Male	40.0	35.7	30.8	53.9
Female	60.0	64.3	69.2	46.2
ASA class				
I	47.5	50.0	46.2	46.2
II	52.5	50.0	53.8	53.8
Success				
Yes	60.0	71.4	76.9	46.2

Success was defined as no pain on access.

Overall, success on access for all three groups was 60%; 75% of patients with no sensitivity to cold stimulus after the initial 15 minutes reported no pain during access. For patients who took acetaminophen only, 90% of those reporting no sensitivity to cold stimulus after 15 minutes also reported no pain during access. For those who took the combination of acetaminophen and ibuprofen, this percentage of success was 80%, whereas only 54% of the patients who took the placebo had a successful outcome. Again, after adjusting for gender, age, and ASA class, this difference was not statistically significant at the .05 level (Tables 3 and 4).

Discussion

Cold testing is widely regarded as effective for diagnosing pulpal vitality. Petersson et al. (32) found that the probability that an accurate positive cold response was an indicator of pulp vitality was 90%, versus 83% with the heat test and 84% with the electrical test. Fuss et al. (33) showed that tetrafluoroethane cold spray was more reliable than ethyl chloride or ice. We defined irreversible pulpitis as a painful response to a cold stimulus that lingers for several minutes after the stimulus is removed. Only patients that met this criterion were included in this study.

The choice of acetaminophen and ibuprofen as premedications in this study came from the facts that these are relatively safe, fast-acting analgesics that also control inflammation and that they had not been used in a similar study. A landmark study of relief of preoperative endodontic pain relief was conducted by Gallatin et al. (29). Depo-Medrol was given intraosseously to reduce inflammation and pain when patients could not be treated for several days. Significant pain reduction was observed compared to placebo.

The drugs studied could be clinically useful premedications because of their fast-acting, rapid release gel formulation and effectiveness on dental pain (33, 34). When acetaminophen or ibuprofen were administered as a postoperative medication, considerable pain relief was reported at 30 minutes (34, 35). Moore et al. (36) compared the efficacy of locally applied aspirin and acetaminophen in controlling postoperative pain after third molar surgery and found acetaminophen had a significant analgesic effect. Bjornsson et al. (37) found that 1,000 mg of acetaminophen preoperatively significantly reduced pain in the first hour after third molar surgery when compared to 500 mg of naproxen. Mehlisch (31) stated that for the treatment of mild to moderate dental pain, acetaminophen continues to be an appropriate option.

There is much controversy on the ideal dosage for the patient with acute pain. In an emergency services department, Neighbor and Puntillo (38) compared intramuscular ketolorac (50 mg) and oral ibuprofen (800 mg) for relief of acute pain and found them equivalent and effective in 60% of the cases. Seymour and Ward compared 200, 400, and 600 mg ibuprofen and noted a trend toward improved relief with 600 mg over 400 mg (35). Bjornsson et al. compared 600 mg ibuprofen to 1,000 mg Paracetamol (acetaminophen), finding pain relief similar (39). Nielsen et al. (40) showed that 800 mg ibuprofen was superior to 400 mg in a study of laser-induced pain. Menhinick et al. (41) found that a combination of 600 mg of ibuprofen and 1,000 mg of acetaminophen was significantly more effective than 600 mg of ibuprofen alone in controlling postoperative dental pain. Skoglund et al. (42) compared 1,000 mg and 2,000 mg acetaminophen and reported total analgesia with 1,000 mg; therefore, no reason to increase the dose.

For these reasons, 1,000 mg of acetaminophen or the combination of 1,000 mg of acetaminophen and 600 mg of ibuprofen were chosen for this study, as was the dosage time of 30 minutes before treatment. It may have been informative to have a group that received 600 mg of ibuprofen only but Bjornsson's group (39) showed no significant difference between 600 mg of ibuprofen and the combination of 600 mg of ibuprofen and 1000 mg of acetaminophen.

The VAS test showed little reduction of pain because of the medication. We concluded that a clinician might not see pain reduction reported by the patient, but our results suggest success of local anesthetic nonetheless.

Two percent lidocaine was chosen because several studies comparing lidocaine to other anesthetics, including articaine, in the success of pulpal anesthesia found little or no significant difference in efficacy. Mikesell et al. (43) concluded that 4% articaine with 1:100,000 epinephrine was similar to 2% lidocaine with 1:100,000 epinephrine in inferior alveolar nerve blocks. Claffey et al. (44) found the IAN success rate for patients with irreversible pulpitis receiving articaine was 24% and for the lidocaine solution success was 23%. Tofoli et al. (45) found 4% articaine with 1:100,000 or 1:200,000 epinephrine equally effective for IAN block.

The use of 3.6 ml of 2% lidocaine with 1:100,000 epinephrine administered to each patient in this study produced lip numbness for each patient. They all reported that they felt completely numb for the endodontic therapy. It is a commonly held belief that lip numbness implies pulpal anesthesia, yet in two clinical trials only 80% and 75% of the patients with lip numbness had

TABLE 4. Multivariate analysis

Group*	Success		
	p-value	Odds ratio (OR)	Confidence interval (CI)
Aceta only	0.3131	1.9	(0.54-15.59)
Aceta/Ibup	0.8847	2.9	(0.37-9.76)
Placebo	Ref		

Aceta, acetaminophen; ibup, ibuprofen.

Success was defined as no pain on access.

Data were for age, gender, and ASA classification.

pulpal anesthesia (32, 33). In this study, the IAN block was successful if the preoperative cold test was negative for 90% of patients that took the 1,000 mg of acetaminophen and for 80% of the patients who took the combination of 1,000 mg of acetaminophen plus 600 mg of ibuprofen. In contrast, only 46% of placebo patients with no sensitivity to cold test had pain on access. Thus, we concluded that cold testing seems to be superior to lip signs for determining when to begin endodontic access for patients with irreversible pulpitis.

Patients with sensitivity before access were given a PDL injection. Only one patient from the 1,000 mg acetaminophen only group, two from the combination 1,000 mg acetaminophen and 600 mg of ibuprofen, and two from the placebo group required PDL injection.

Patients with sensitivity during access were given an intrapulpal injection. In the acetaminophen only and the combination of acetaminophen and ibuprofen groups, two patients from each group needed an intrapulpal injection. For the patients in the placebo group, five patients required intrapulpal injections to achieve profound anesthesia in these teeth.

The results from this study showed there were no statistically significant differences between 1,000 mg of acetaminophen, the combination of 600 mg of ibuprofen and 1,000 mg of acetaminophen, and placebo on the success of inferior alveolar block in patients with irreversible pulpitis. However, there was a trend toward better clinical outcome with these medications versus placebo.

In conclusion, the administration of premedication with acetaminophen or a combination of acetaminophen and ibuprofen on the success of inferior AEN for teeth with irreversible pulpitis appears promising, although the pilot study showed no statistically significant difference versus placebo.

Acknowledgments

The authors thank Stephen F. Bernard, RPh, UAB Hospital Pharmacist, for preparing and randomizing medication samples.

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