A Comparison of Postoperative Pain Experience Following Periodontal Surgery Using Two Local Anesthetic Agents*

Eric Thomas Linden,† Herbert Abrams,‡ James Matheny,§
Alan L. Kaplan,‖ Raymond A. Kopczyk¶ and Samuel J. Jasper, Jr.**

Accepted for publication 23 August 1985

THIS CONTROLLED, DOUBLE-BLIND, SPLIT-MOUTH STUDY was designed to evaluate postoperative pain experience following periodontal surgery on 20 patients. Two commercially available local anesthetic agents, bupivacaine HCl and lidocaine HCl, were used. Periodontal surgeries were standardized to minimize differences in difficulty, extent and time. A patient questionnaire was used to collect data for the 24-hour observation period following periodontal surgery. During this period, pain perception was assessed by visual analogue scales. The results indicated that when bupivacaine was used, there was less postoperative pain, fewer postoperative analgesics taken and a longer period of "numbness" (anesthesia) as compared to lidocaine. The patients expressed a strong preference for bupivacaine over lidocaine.

Effective pain control during and after periodontal surgery is essential in a periodontal practice. One way of achieving this goal could be the use of a long-acting local anesthetic such as bupivacaine (Marcaine).†† Bupivacaine is marketed in dental carpules for use as a local anesthetic in clinical dentistry. The manufacturer claims a "prolonged analgesic effect for better patient comfort in addition to keeping patients pain-free for a longer period of time." They also claim "a decreased need for postoperative analgesics."[1]

Numerous clinical trials in dentistry have studied the effects of bupivacaine in patients undergoing oral surgery.[2-7] Another study used endodontic patients.[8] To our knowledge, there have been no published trials evaluating the use of bupivacaine in periodontal surgery.

The primary objective of this study was to compare the use of 0.5% bupivacaine with epinephrine (1:200,000) to 2% lidocaine‡‡ with epinephrine (1:100,000) during and following periodontal surgery to evaluate differences in: postoperative pain; postoperative analgesics needed; and total time of "numbness" (anesthesia) experienced by the patient.

MATERIALS AND METHODS

Twenty male and female patients ranging in age from 20 to 65 years were selected from the patient pool in the postdoctoral periodontics clinic at the University of Kentucky College of Dentistry. Patients who had a history of systemic illness or were taking any medication which could interact with the local anesthetic agents were eliminated from the study.

The procedures involved in the study were thoroughly explained to the patient. Before any surgical procedure was begun, the patient was required to read and sign an "Informed Consent Form" provided by the investigator.

* This study was submitted to the University of Kentucky Graduate School by the primary author in partial fulfillment of the requirements for the degree of Master of Science in Dentistry, Department of Periodontics, University of Kentucky College of Dentistry, Lexington, KY 40536.

† Former graduate student in the Department of Periodontics, University of Kentucky College of Dentistry, Lexington, KY 40536. Now in private practice in Massachusetts.

‡ Director of Graduate Periodontics, University of Kentucky College of Dentistry.

§ Professor, Department of Oral Biology, University of Kentucky College of Dentistry.

‖ Department of Community Dentistry, University of Kentucky College of Dentistry.

¶ Chairman, Department of Periodontics, University of Kentucky College of Dentistry.

** Associate Professor, Department of Periodontics, University of Kentucky College of Dentistry.

†† Cook Waite Company, New York, NY.

‡‡ Graham Chemical Company/Minimax Corporation, Jamaica, NY.

The study was designed as a double-blind trial to avoid investigator bias and to strengthen the credibility of the patients' subjective evaluations. To accomplish this goal, a special procedure was instituted to manufacture identical carpules for this study. The commercially available 0.5% bupivacaine HCl with epinephrine 1:200,000 was used as manufactured. Additionally, the label on the carpule was removed by the investigator and placed into a sealed container labelled "A." In order to have a 2% lidocaine HCl with epinephrine 1:100,000 unlabeled carpule identical to the 0.5% bupivacaine unlabeled carpule, the red rubber plungers from the 0.5% bupivacaine were obtained and used with a carpule containing 2% lidocaine with 1:100,000 epinephrine. The lidocaine-containing carpules were then placed in a sealed container labeled "B" for the purposes of this research investigation. This process was accomplished after careful evaluation by a leading manufacturer* of local anesthetics. This evaluation included: biocompatibility, standardization, microbiological control, and solution testing.

Eight carpules of either 0.5% bupivacaine or 2% lidocaine were removed from the respective containers (A and B) and placed into identical envelopes with the only difference being a coded number on the outside. The allocation of these numbers to the envelopes was done by a second party not directly involved with this investigation. The coded system was used so that the investigator could not identify the anesthetic agent. This code was readily available to the principal investigator and other faculty members in case a medical emergency were to arise.

Each patient was assigned a "Patient Number" depending on when he entered the study. The second party, not directly involved in this investigation, assigned each patient (numbers 1–20) two envelopes with coded numbers. One of the coded envelopes contained bupivacaine carpules and the other lidocaine carpules. A "master code" sheet with the numbering system and the identity of the anesthetic within each coded envelope was developed. The second party then randomly assigned the anesthetic given, the quadrant to be treated surgically, and the order of the surgeries (i.e., left or right side), so that the first anesthetic given to a patient and order of the surgeries varied. In effect, a double-blind system ensured that neither the investigator nor the patient knew what anesthetic was administered.

Periodontal surgeries were performed on the 20 selected patients using either the maxillary or mandibular arch. The first surgical procedure was done on one quadrant and the second surgical procedure was accomplished on the opposite quadrant in the same arch. The procedures were performed on separate occasions at least 2 weeks apart but within a 6-week period. All surgeries were performed in the morning hours to provide the patient and investigator sufficient time to evaluate the postoperative discomfort before bedtime and to avoid possible diurnal variation in pain response. The same investigator (EL) performed all surgical procedures. The surgeries were standardized as closely as possible. An attempt was made to select cases requiring the same type and extent of surgery as well as comparable difficulty levels. At the completion of surgery, Coe-Pack† dressing was applied to the surgical site.

Standardized anesthetic techniques were used. In mandibular quadrants, inferior alveolar, lingual and long buccal injections were administered. In maxillary quadrants, a posterior superior alveolar block, local infiltration and palatal injection were administered. The same number of carpules were injected at each site to achieve "surgical anesthesia." In block injections, 1½ carpules were deposited (inferior alveolar, lingual and posterior superior alveolar). An additional one carpule was deposited for the long buccal and local infiltration injections. The palatal anesthesia was obtained with 1 carpule by giving a greater palatine injection and localized palatal infiltration. Effective surgical anesthesia was determined by noting the patient's response to a sharp end of a No. 7 explorer which was used to "sound" the soft tissues in the surgical site. This was done 2 minutes after completion of anesthetic administration. This technique of evaluating surgical anesthesia was repeated every minute for 5 minutes. If surgical anesthesia was not obtained in 5 minutes, a reinjection was administered. If more than five carpules of anesthetic agent were necessary to achieve surgical anesthesia, then the case was considered an anesthetic failure and was eliminated from the study.

For the purposes of this research investigation, "numbness" was defined as the loss of feeling as perceived by the patient. This was calculated by taking the total time from "surgical anesthesia" to the "time numbness wore off."

A standardized reproducible "Preoperative Explanation Form" was read to all the patients before each of the surgical procedures. At that time, all the patients received prescriptions for Tylenol No. 3‡ (Acetaminophen 300 mg and codeine phosphate 30 mg) and were also given standardized "Instructions for Patients Following Periodontal Surgery and Patient Questionnaire" (Fig. 1) forms.

Patients were instructed not to take any pain medication until pain or discomfort occurred. This pain medication *was only to be Tylenol No. 3* as instructed. Postoperative pain and discomfort were assessed at the immediate postoperative 2, 4, 6, 8, 10, 12 and 24-hour

* Graham Chemical Company/Minimax Corporation, Jamaica, NY.

† Coe-Pak, Coe Laboratories, Chicago, IL.

‡ McNeil Pharmaceutical Company, Dorado, Puerto Rico.

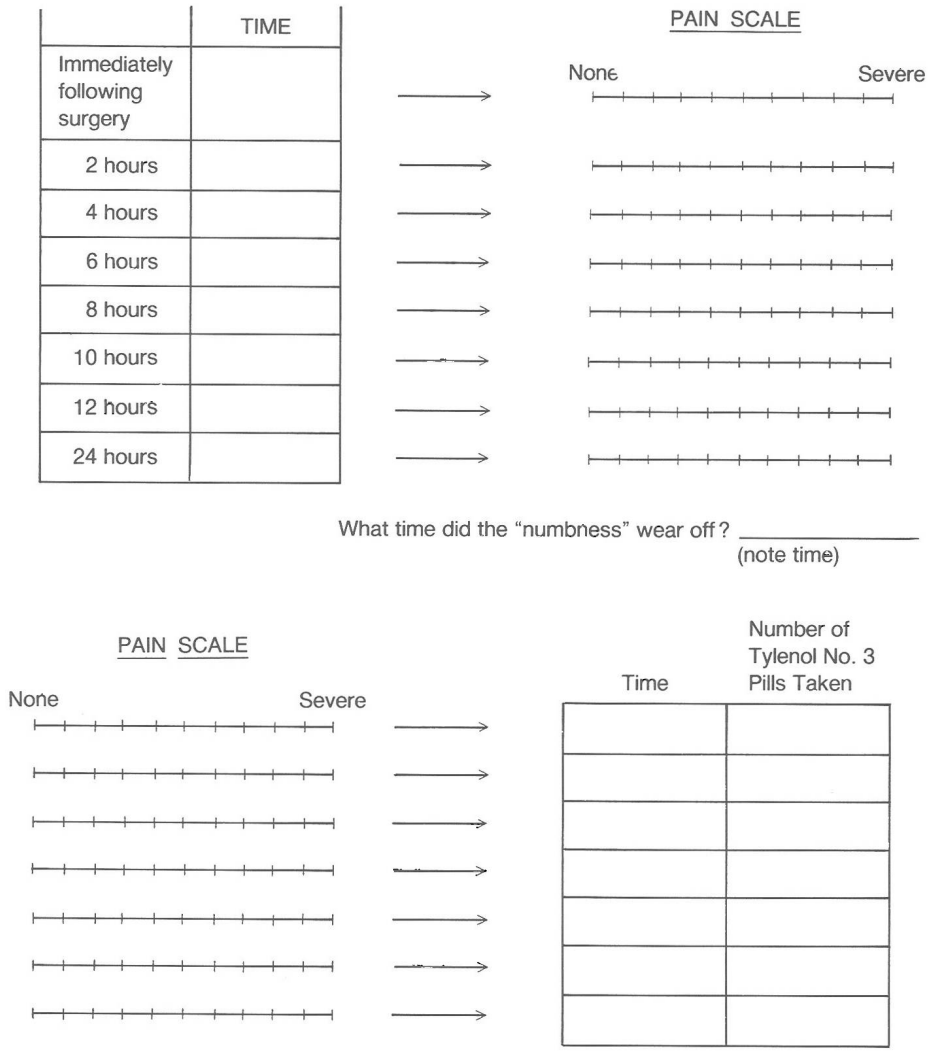

Figure 1. *Patient questionnaire.*

time periods using a patient-completed questionnaire (Fig. 1). Included in the questionnaire were visual analogue scales to determine pain experience.

Following each surgical procedure, a form was filled out by the investigator to record information about the surgery and anesthetic used. This form included a subjective assessment of the degree of hemostasis achieved during the surgical procedure (i.e., excellent, limited or poor). To confirm that the patient questionnaire was appropriately filled out, and to record the patient's anesthetic experience, the investigator called the patient at 6:00 PM the day of the surgery and 24 hours after completion of the surgery.

The hypothesis that "the patients' perception of pain over the eight time periods following surgery was different for bupivacaine and lidocaine" was examined using a three-factor repeated measures analysis of variance. The repeated measures occurred on both the anesthesia factor and the time factor. The third factor was the arch treated surgically. Eleven of the patients received two quadrants of surgery on the maxillary arch and nine patients received surgery on the mandibular arch. All tests were performed using the Statistical Analysis System computer software package in which the repeated measures analysis involved the use of the general linear model procedure. The *t* test for related samples was then used to determine at exactly which time periods the two anesthetic agents differed. The *t* test for related samples was also used to test the hypothesis that both the mean number of postoperative analgesic tablets and the mean time elapsed until "numbness" subsided was different for the two anesthetics. Lastly, the chi-square test was used to determine if the patients preferred one anesthetic over the other.

RESULTS

Since it was found that the surgically treated arch was not significant either as a main factor or as an interactive factor with anesthesia and time, the data were pooled across the arch and analyzed for the two remaining factors.

Table 1
Postoperative Pain Perception: Statistical Analysis

Source of variation	Degrees of freedom	Sum of squares	Mean square	F	*P*
Anesthetic	1	77.03	77.03	15.09	0.0001
Anesthetic * patients within group	318	1623.57	5.11		
Time	7	270.92	38.71	8.45	0.0001
Time * patients within group	312	1429.68	4.58		
Anesthetic * time	15	368.75	24.59	5.62	0.0001
Anesthetic * time * patients within group	304	1331.85	4.38		

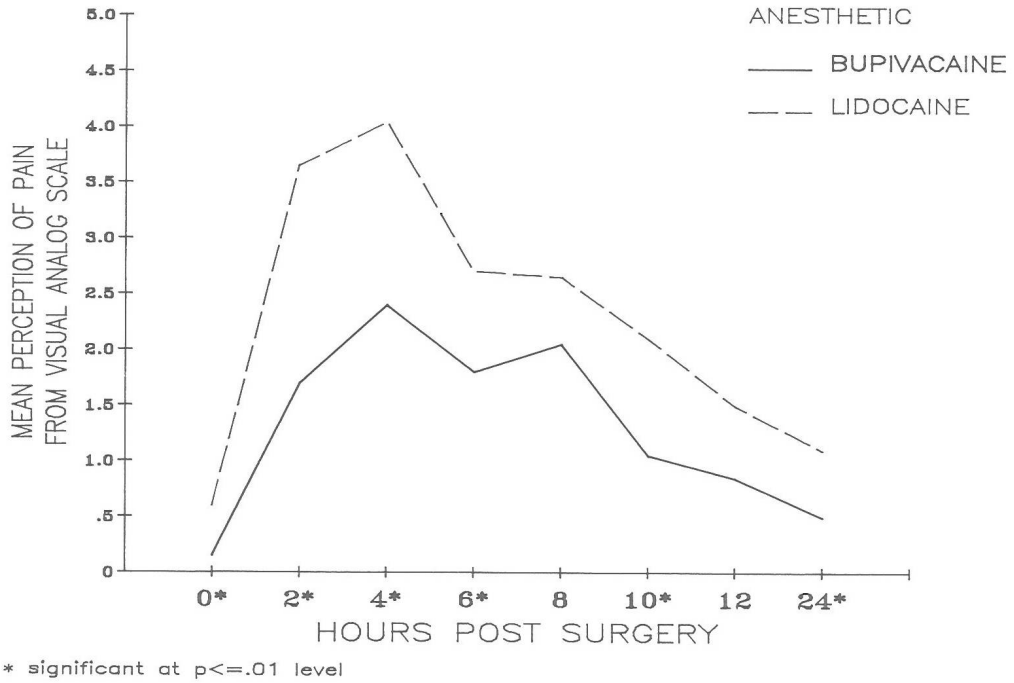

Figure 2. *Mean perception of pain for two types of anesthetic at eight time intervals.*

There was a statistically significant difference ($P < 0.0001$) in the perception of pain with bupivacaine and lidocaine (Table 1) over all the time periods for the 20 patients. Less pain was perceived with bupivacaine across all time periods. Following periodontal surgery, pain perception was greater for lidocaine. This was found to be statistically significant ($P \leq 0.01$) in the immediate postoperative 2, 4, 6, 10 and 24-hour time periods and can be visualized on a graph with the mean perception of pain plotted against time for both anesthetics (Fig. 2).

There was a significant difference in the mean number of postoperative analgesic tablets taken. The bupivacaine group took 2.8 postoperative analgesic tablets as compared to 4.3 for the lidocaine group. This was found to be of statistical significance ($P \leq 0.006$). The differences in frequency distribution of the postoperative analgesics taken in both anesthetic groups are shown in Table 2. Thirty per cent of the lidocaine group took six or more pills during the entire postoperative period compared to 5% of the bupivacaine group (Table 2). Sixty-five per cent of the lidocaine group took more than three pills during the postoperative period while only 30% of the Marcaine bupivacaine group took an excess of three pills (Table 2).

Table 2
Frequency Distribution of Postoperative Analgesics Taken with Bupivacaine and Lidocaine for the 20 Patients

Number of pills taken	Number of patients		Cumulative per cent of total	
	Bupivacaine	Lidocaine	Bupivacaine	Lidocaine
0	2	3	10%	15%
1	1	0	15%	15%
2	6	1	45%	20%
3	5	3	70%	35%
4	3	5	85%	60%
5	2	2	95%	70%
6	1	1	100%	75%
7	0	1		80%
8	0	4		100%

The bupivacaine group was "numb" for a mean time of 5.9 hours as compared to 3.9 hours for the lidocaine group. This represents a 51% increase in the duration of "numbness" for the bupivacaine group (Table 3) which was found to be statistically significant using the *t* test for related samples ($P < 0.0003$). However, there

Table 3
Total Time of "Numbness" for Bupivacaine and Lidocaine in Hours

Patient	Bupivacaine	Lidocaine
1	4.4	3.2
2	3.7	4.3
3	9.1	4.8
4	4.5	3.0
5	7.5	3.4
6	8.0	3.4
7	6.4	6.6
8	6.4	5.1
9	4.5	3.3
10	9.6	9.5
11	6.0	6.0
12	6.7	4.6
13	7.5	4.2
14	9.4	5.0
15	9.3	4.6
16	9.0	4.8
17	8.0	4.3
18	3.2	3.6
19	5.9	5.3
20	8.2	8.5
Mean	5.9	3.9
Standard deviation	4.1	3.4

was no significant correlation between "numbness" and pain perception ($P \leq 0.78$).

Seven days after the completion of the second surgery each patient was asked, "Which would you prefer for future surgeries?" Bupivacaine was preferred by 14 of 19 patients (74%). Using the chi-square test ($P < 0.001$), this was found to be statistically significant. One patient did not respond.

After breaking the code, reviewing the surgical records and the investigator's questionnaire, it was found that the bupivacaine group demonstrated more bleeding during surgery in 11 of the 20 patients (55%) when compared to lidocaine.

DISCUSSION

The results of this study are in agreement with several studies done with bupivacaine in oral surgery and endodontics.[2-8] Each of these studies showed less postoperative pain and a "greater length of time of numbness" with bupivacaine.

However, previous studies[2-8] with bupivacaine in oral surgery and endodontics did not use visual analogue scales but used descriptive scales to assess pain perception. The visual analogue scale is believed to be a more sensitive and better measure of the magnitude of pain than descriptive scales.[9,10] Investigations using visual analogue scales showed that patients prefer a horizontal scale as opposed to vertical scales or just plain descriptive scales.[9-11] Clinically, it has been shown to be a reliable and satisfactory method of assessing subjective pain responses in patients.[10,12,13]

By using the double-blind experimental design, the results should be more reliable than previous studies which did not use visual analogue pain response measurements, control subjects or split mouth techniques.[3,5,6] In addition, other studies did not use commercially available dental preparations (carpules) of bupivacaine[2,4] nor did they all include any surgical therapy.[8]

The results of this study showed that bupivacaine has a longer duration of "numbness" (51% greater) than lidocaine. This is one of the properties of bupivacaine that may make it desirable in periodontal surgery. Postoperative pain perception was significantly less for bupivacaine than for lidocaine. Although no significant correlation was found between "numbness" time and postoperative pain, there may be other factors that could influence these two variables. This could be an area for further research in the future.

Previous studies have shown that postoperative pain is common following periodontal surgery.[14,15] An effective way to control postoperative pain is to use analgesics.[16,17] Fewer postoperative analgesics were taken with bupivacaine than with lidocaine. This property of bupivacaine compared to lidocaine makes it a more effective anesthetic for periodontal surgery by allowing the patient to more comfortably tolerate the postoperative period without taking additional analgesics.

Based on clinical impression, there is no difference in the onset of "surgical anesthesia" as defined by the criteria established by this study. This impression agrees with other bupivacaine studies.[2,4,5,8]

Hemostasis is very important for visualizing the surgical field during periodontal surgery. Clinically it was observed by the operator that the bupivacaine group demonstrated more bleeding during periodontal surgery. Thus, it might be advantageous for the concentration of epinephrine to be increased to reduce bleeding during periodontal surgery.[18-20] The availability of bupivacaine with 1:100,000 and 1:50,000 epinephrine concentration would allow the periodontist much more flexibility in the choice of anesthetic agents in controlling bleeding.

Fourteen of 19 patients (74%) in this study preferred bupivacaine over lidocaine for future periodontal surgeries. This may be attributed to less postoperative pain perception, increased numbness time, less need for postoperative analgesics or any combination of these reasons.

ACKNOWLEDGMENTS

We would like to express our sincere appreciation to Cook Waite Company and Graham Chemical/Minimax Corporation for help and encouragement in initiating this investigation. We also acknowledge the support of the Southern Academy of Periodontology in initiating this project. We are extremely grateful to Melissa Leonard for all of her time in preparing this manuscript.

REFERENCES

1. Cook Waite Laboratories: New to Dentistry: Marcaine HCl. *J Am Dent Assoc* **107:** 752, 1983.

2. Feldman, C., and Nordenram, A.: Marcaine in oral surgery: a clinical comparative study with carbocaine. *Acta Anesthesiol Scand* (suppl.) **23:** 409, 1966.

3. Nespeca, J. A.: Clinical trials with bupivacaine in oral surgery. *Oral Surg* **42:** 301, 1976.

4. Laskin, J. L., Wallace, W. R., and Deleo, B.: Use of bupivacaine hydrochloride in oral surgery—a clinical study. *J Oral Surg* **35:** 25, 1977.

5. Pricco, D. F.: An evaluation of bupivacaine for regional nerve block in oral surgery. *J Oral Surg* **35:** 126, 1977.

6. Trieger, N., and Gillen, G. H.: Bupivacaine anesthesia and postoperative analgesia in oral surgery. *Anesth Prog* **26:** 20, 1979.

7. Chapnick, P., Baker, G., and Monroe, C.O.: Bupivacaine anesthesia in oral surgery. *Can Dent Assoc J* **46:** 441, 1980.

8. Moore, D. A., and Dunsky, J. L.: Bupivacaine anesthesia—a clinical trial for endodontic therapy. *Oral Surg* **55:** 176, 1983.

9. Huskisson, E.: Visual analogue scales. R. Melzack (ed), *Pain Measurement and Assessment*, pp 33–37, New York, Raven Press, 1983.

10. Sriwatanakul, K., Kelvie, W., and Lasagna, L.: The quantification of pain: an analysis of words used to describe pain and analgesia in clinical trials. *Clin Pharmacol Ther* **32:** 143, 1982.

11. Downie, W. W., Leatham, P. A., Rhind, V. M., et al.: Studies with pain rating scales. *Ann Rheum Dis* **37:** 378, 1978.

12. Scott, J., and Huskisson, E. C.: Vertical or horizontal visual analogue scales. *Ann Rheum Dis* **38:** 38: 560, 1979.

13. Joyce, C. R., Zutshi, D. W., Hrubes, V., and Mason, R. M.: Comparison of fixed interval and visual analogue scales for rating chronic pain. *Eur J Clin Pharmacol* **8:** 415, 1975.

14. Strahan, J. D., and Glenwright, H. D.: Pain experience in periodontal surgery. *J Periodont Res* **2:** 163, 1967.

15. Brenman, H. S., and Cohen, W.: Pain, periodontia and pain killers. *Dent Prog* **2:** 9, 1961.

16. Cooper, S. A., and Beaver, W. T.: A model to evaluate mild analgesics in oral surgery outpatients. *Clin Pharmacol Ther* **20:** 241, 1976.

17. Upton, L. G.: Evaluation of sedative-analgesic combination for postoperative pain. *Oral Surg* **47:** 513, 1979.

18. Covino, B. G.: Pharmacology of new local anesthetic agents. *Int Anesthesiol Clin* **16:** 1, 1978.

19. Tucker, G. T.: Binding of anilide-type local anesthetic in human plasma: I. Relationships between binding, physico-chemical properties and anesthetic activity. *Anesthesia* **33:** 287, 1970.

20. Covino, B. G., and Giddon, D. B.: Pharmacology of local anesthetic agents. *J Dent Res* **60:** 1454, 1981.

Send reprint requests to: Eric Linden, DMD, MS, Department of Periodontics, College of Dentistry, University of Kentucky, Lexington, KY 40536.