

# Adverse Reactions Triggered by Dental Local Anesthetics: A Clinical Survey

Eliezer Kaufman, DMD,\* Shai Goharian, DMD,\*\* and Yosi Katz, DMD\*\*

\*Department of Hospital Oral Medicine, Hebrew University–Hadassah Medical Center, School of Dental Medicine founded by the Alpha Omega Fraternity, Ein Kerem, Jerusalem, Israel, and \*\*Oral Medicine Section, Israeli Defense Forces Medical Corps and Sheba Medical Center, Tel Hashomer, Israel

One hundred and seventy-nine patients completed a questionnaire focusing on adverse reactions to dental local anesthetics as manifested by 16 signs and symptoms. Twenty-six percent of the participants reported having at least 1 adverse reaction. It was found that most of the adverse reactions occurred within the first 2 hours following the injection of local anesthetics. Pallor, palpitations, diaphoresis, and dizziness were the most common adverse reactions reported in the study. The results pointed to a significant relationship between anxiety, gender, injection technique, and procedure with a higher incidence of adverse reactions.

**Key words:** Adverse reactions; Local anesthetics; Dental treatment; Dental anesthesia complications.

Local anesthetic administration is a common procedure in dental practice, and serious complications are rare when the drugs are administered carefully and within recommended dosage limits. When adverse reactions do occur, they are usually of a reversible and temporary nature, though the potential for a more serious response does exist.

Statistics related to complications and side effects from oral regional anesthetics are meager. Only a few studies have addressed the problem of complications associated with local dental anesthetics.<sup>1-3</sup>

The purpose of this study was to evaluate the frequency, time of onset, and characteristics of adverse reactions to dental local anesthetics. There was also an attempt to analyze what variables influence adverse reactions.

## METHODS AND MATERIALS

The study was conducted in an army clinical center. Consecutive patients were requested to participate, and

none of the soldiers who had come to the center for dental treatment refused.

The study population consisted of 64 females and 115 males. The average age was 26.34 years, ranging from 18 to 50 years. The majority of patients (58%) were  $\leq 21$  years, while 32% of the population was between 22 and 40 years, with the remaining 10% older than 40 years. The general health of the patients was ASA 1–2. All but 9 of the patients had previously received a dental local anesthetic injection.

The patients completed a questionnaire focusing on 16 indicators and symptoms of adverse reaction to local anesthetics (LA) and also recorded the time of occurrence of the adverse reaction. The questionnaire also included a 10-cm anxiety visual analog scale ranging from 0 (no anxiety) to 10 (extremely high anxiety), in which the patients were asked to indicate the degree of anxiety after completion of the dental treatment. The participants also answered questions dealing with the history of any previous local dental anesthetic-related reactions based on the same 16 indicators and symptoms of adverse reaction. Another 10-cm visual analog scale was given dealing with the quality of local anesthesia, where 0 represented total ineffective analgesia and 10 represented complete local analgesia.

A questionnaire dealing only with the independent variables was filled in by the operator, who noted the

Received June 29, 1999; accepted for publication January 4, 2001.

Address correspondence to Dr Eliezer Kaufman, Department of Hospital Oral Medicine, Hebrew University–Hadassah Medical Center, School of Dental Medicine, Ein Kerem, Jerusalem, Israel.

**Table 1.** Type of Local Anesthetic Solution

<i>Preparation</i>	<i>N</i>	<i>Composition</i>
Lidocomplex Teva	143	Lidocaine hydrochloride 2% + noreadrenaline bitartrate 0.002% + vasopressin 25 IU sodium metasulfite
Xylocaine Espe	22	Lidocaine hydrochloride 2% + epinephrine 1 : 100,000 sodium metasulfite
Tevacaine Teva	15	Mepivacaine hydrochloride 3%

local anesthetic solution, whether the injection yielded a positive aspiration, and the type of procedure.

The procedures performed consisted mainly of exodontia of various degrees of difficulty (oral maxillofacial surgery); restorations, including fillings and crown and bridge (restorative dentistry); soft tissue periodontal surgery (periodontics), and various root canal treatments (endodontics).

The 3 local anesthetic solutions used in the study are represented in Table 1.

All injections were performed with a carpule-type dental syringe with a harpoon-type piston that enabled aspiration. Needles in use were long or short 27 gauge. The numbers and types of local anesthetic injections are listed in Table 2.

An analysis was made of the relationship between independent variables (local anesthetic solution, injection technique, and the type of procedure) and dependent variables (cardiovascular, peripheral tissue, and central nervous system involvement).

Logistic regression was used to examine the effect of anxiety on presence of adverse reactions while controlling the other variables.<sup>4</sup>

## RESULTS

The average anxiety level on a visual analog scale was 5.17.

None of the subjects reported having had previous adverse reactions following dental local anesthesia.

### Characteristics of Adverse Reactions

Data analysis showed that anxiety, gender, injection technique, and procedure were all significant factors re-

**Table 2.** Numbers and Types of Local Anesthetic Injections

<i>Technique</i>	<i>n</i>
Local infiltration	112
Mandibular blocks	87
Maxillary blocks	2
Mental blocks	2
Posterior alveolar block	3
Intraligamentary injections	3
Infraorbital	2

lated to a higher incidence of adverse reactions. Age, the type of anesthetic solution, and the number of carpules were not found to be significant. These model results can be found in Table 3.

The study questionnaire included 16 possible adverse reactions. Two of the adverse reactions, skin rash and swelling, did not occur during this study and therefore were omitted from the final results, with only 14 adverse reactions remaining in the analyses.

### Frequency of Adverse Reactions

Of the 179 subjects participating in the study, 47 (26.2%) reported 1 of the 14 listed adverse reactions to local anesthetics. Eight (4%) out of these 47 patients reported 2 of the symptoms and 3 patients (2%) reported 3 reactions. Table 4 illustrates the percent occurrence by procedure of the 14 adverse reactions within the entire study population.

No serious, life threatening adverse reactions occurred during this study.

### Procedure and Adverse Reactions

Incidence of adverse reactions by category is presented in Table 5. For analysis purposes, all dental procedures were grouped into 4 main categories: (1) surgery, (2) restorative dentistry and crown and bridge work, (3) endodontic therapy, and (4) periodontal therapy. Endodontic therapy yielded the highest adverse reaction (53%) in comparison with 33% in crown and bridge work, 22% in periodontics, and 17% in oral surgery. The difference in adverse reactions between the 4 treat-

**Table 3.** Test of Significance From the Logistic Regression Model

<i>Source</i>	<i>P-Value*</i>
Age	.1667
Gender	.0240
Anxiety	.0043
Anesthetic solution	.2472
Number of carpules	.1313
Injection technique	.0008
Procedure	.0445

\* From Wald chi square.

**Table 4.** Percent Occurrence of Adverse Reactions by Procedure

Adverse Reaction	Total (%)	Surgery (%)	Restoration (%)	Endodontics (%)	Periodontics (%)
Palpitations	6.1	6.4	2.3	5.8	11.1
Diaphoresis	6.1	5.3	0.7	5.9	7.4
Pallor	5	3.2	0	17.6	12.5
Dizziness	4.4	4.3	2.3	17.6	0
Headache	2.7	0	2.3	23.5	0
Confusion	2.2	0	2.3	11.7	3.7
Diplopia	1.6	1.1	2.3	5.8	0
Postoperative pain at site of injection	1.6	1.1	2.3	5.9	0
Postoperative abnormal sensation	1.6	0	2.3	0	0
Postoperative trismus	1.6	0	4.7	5.9	0
Motor paralysis (bells palsy)	1.1	1.1	0	5.9	0
Other motor paralysis	0.55	2.2	2.3	0	0
Postoperative sensory paralysis	0.55	0	2.3	0	0
Syncope	0.55	1	0	0	0

**Table 5.** Incidence of Adverse Reactions by Category\*

Category	Number of cases	% Adverse Reactions
Procedure		
Surgery	93	17
Restorative crowns and bridges	42	33
Endodontics	17	53
Periodontics	27	22
Gender		
Male	115	30
Female	64	17
Injection technique		
Infiltration	81	11
Mandibular block	30	30
Maxillary block	57	35
Others	6	83

\* Chi-square test.

ment procedures was found to be significant. Multiple comparisons of the 4 procedures were conducted using a chi-squared test on the unadjusted values with the Bonferonni correction for multiple comparisons.<sup>4</sup> Only surgery versus endodontics was significant at the .05 level.

**Anxiety and Adverse Reactions**

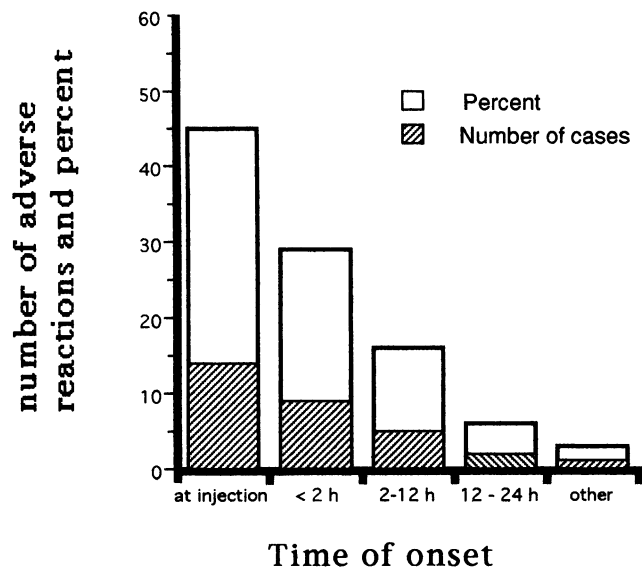
Anxiety was found to be significant, with higher levels of anxiety being associated with adverse reactions. Of the 9 patients who had never experienced dental local anesthesia, 4 (44%) reported an adverse reaction. These same patients reported having a high level of anxiety (8.125).

**Gender and Adverse Reactions**

There was a significant relationship between gender and adverse reactions to dental local anesthetics (Table 4). There was a higher incidence of adverse reactions in males than in females (Table 5).

**Injection Technique and Adverse Reactions**

As mentioned above, there was a significant association between injection technique and incidence of adverse reactions (Table 5). Even though the majority of injections consisted of local infiltration or mandibular and maxillary blocks, the less frequently used injection techniques such as intraligamentary, infraorbital, and mental nerve blocks (ie, others) resulted in higher frequencies of adverse reactions.



Time of onset of adverse reactions following local anesthetic injection.

### Time of Adverse Reaction Onset

The results in the Figure indicate that, in 45% of the cases, adverse reactions occurred at the time of injection. Twenty-nine percent of the reactions occurred within the first 2 hours following the injections. As the time span increased from the moment of injection, the occurrence of adverse reactions decreased.

## DISCUSSION

Local anesthetics are the most frequently injected drug in the dental clinical situation. It has been estimated that, in the United States alone, about 6 million dental cartridges are injected weekly or that more than 300 million are injected annually.<sup>5</sup> Adding these figures to comparable numbers in Western Europe and Japan, we are dealing with approximately 1 billion injections of local anesthetics per year.

Thus, it could be expected that local anesthetics would be a major factor in drug-related adverse reactions in the dental office. There are reports in the literature stating frequencies of as high as 11.5%,<sup>6</sup> though serious, life-threatening situations are rare.

The prevalence of adverse reactions in the present study, 26.2%, is therefore comparatively high, especially when compared with the incidence rate of another recent detailed study by Daublander et al,<sup>1</sup> which had an overall incidence of only 4.5%. In yet another study,<sup>3</sup> just 6-13% of the patients were reported to have adverse reactions to local anesthetics.

A number of possible explanations could clarify the

high incidence rate in the present study. First, the list of adverse reactions in this investigation was very detailed and included postinjection sequelae that were not emphasized in the other works. Second, the discrepancy could be attributed to the subjective nature of the questionnaire. This may have focused patient attention to even minor reactions that would usually be ignored or attributed by the patient to the treatment.

And finally, the high incidence rate in the present research could be attributed to the fact that this study was based on the patients' report while the Daublander study depended on the operators' observation. The discrepancy between results reported by the patient and those listed by the operator is well documented in a study conducted by Milgrom et al.<sup>7</sup> Although Milgrom et al dealt with local anesthesia success rates and not adverse reactions, the same principle of disparity between results of operator and patient remains.

In the Daublander study,<sup>1</sup> the typical prevalent reactions were similar to those described in the present study, ie, dizziness, tachycardia, agitation, nausea, and tremor. The reactions in both studies were transient in nature and did not require any intervention. However, in the Daublander work, there was an occurrence rate of 0.07% of severe complications, such as seizures and bronchospasm, while in the present study, no such serious reactions were recorded. This lack of severe adverse reactions can be accredited to the relatively healthy population in the army service. In the much larger sampling used in the Daublander study, severely medically compromised patients were included and, in such cases, the occurrence of rarer and more severe adverse reactions is more likely to appear.

The most serious adverse reaction in the current study was postoperative complete anesthesia, which occurred twice in patients who received mandibular block anesthetics. Another 3 cases of partial residual anesthesia (parasthesia) were recorded, with 1 case in the mandibular block group and 2 cases in the infiltration group. In the retrospective study of Nickel,<sup>8</sup> a molecular explanation for the etiology of neurotoxicity of local anesthetics is hypothesized. Hydrolyzing ester or amide-type local anesthetics might result in an increased concentration of alcohol in the neuron, with toxic effects. However, this explanation remains speculative.

Another interesting finding of the present study was that 4% of the patients reported having 2 adverse reactions and 2% reported having 3 reactions. This could mean that, if an adverse reaction does occur, the operator should be aware of the possibility that other signs and symptoms may follow.

The strikingly high percentage of adverse reactions (44%) among the patients who had never previously experienced dental local anesthesia may possibly be relat-

ed to the high anxiety level among them (8.125). There was a significant relationship between the procedure and the frequency of adverse reactions. It was found that dental local anesthesia for the purpose of endodontics and restorative dentistry yielded higher adverse reactions than oral surgery or periodontics.

It is not surprising to find that injection techniques such as intraligamentary, infraorbital, and mental nerve blocks resulted in a higher incidence of adverse reactions because these techniques are less frequently used and most operators are not as proficient in their use as in other techniques.

Our failure to establish a significant relationship between the number of injections administered in the same procedure and adverse reactions is in line with the Daublander et al<sup>1</sup> work, which found only a weak correlation between patient body weight and the amount of local anesthetics injected.

## CONCLUSIONS

This study points to a higher level of adverse reactions to dental local anesthetic injections than what has been previously accepted. Fortunately, these adverse reactions are usually transient in nature and are not life threatening.

Most adverse reactions (75%) occur at the time of injection or in the first 2 hours after the injection. This 2-hour time frame should focus the operator's attention on careful observation of the patient before, during, and following the dental procedure. The relationship between anxiety and adverse reactions should be further investigated.

## REFERENCES

1. Daublander M, Muler R, Lipp MDW. The incidence of complications associated with local anesthesia in dentistry. *Anesth Prog*. 1997;44:132-141.
2. Lustig JP, Zusman SP. Immediate complications of local anesthetic administered to 1007 consecutive patients. *J Am Dent Assoc*. 1999;130:496-499.
3. Persson G. General side effects of local dental anesthesia. *Acta Odontol Scand*. 1969;35:1-40.
4. Hosmer D, Lemeshow S. *Applied Logistic Regression*. New York: Wiley; 1989.
5. Malamed SF. *Medical Emergencies in the Dental Office*. 4th ed. St Louis, Mo: CV Mosby; 1997.
6. Goldman V, Gray W. A clinical trial of a new analgesia agent. *Br Dent J*. 1968;115:59-65.
7. Milgrom P, Weinstein P, Kaufman E. Student difficulty in achieving local anesthesia. *J Dent Educ*. 1984;48:168-170.
8. Nickel AA Jr. A retrospective study of parasthesia of the dental alveolar nerves. *Anesth Prog*. 1990;37:42-45.