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The Use of Articaine Local Anesthesia in Children Under 4 Years of Age—A Retrospective Report

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A retrospective survey reports the use of articaine hydrochloride as an anesthetic in children under 4 years of age. Data was collected by a record audit in two pediatric dentistry offices. Articaine anesthetic was administered to 211 patients, 29 having additional administrations of the agent. In some instances, the dosages exceeded the recommended concentrations for older children. No adverse systemic adverse reactions were noted on the charts or known to the clinicians. The present report provides initial evidence for the use of articaine in children under 4 years of age.

Systemic toxic reactions from the use of local anesthetics are relatively uncommon complications in dentistry. Nonetheless, two recent reviews have documented instances of serious morbidity and mortality in pediatric patients.[1,2] Young children are more likely to experience toxic reactions than adults because of their smaller anatomic proportions. The ability to recognize toxic reactions in small children is also limited. Initial signs of toxicity, such as circumoral numbness, tinnitus, or dizziness, may be readily identified by an adult or older child but may go unnoticed in the young or sedated child. The first manifestations of toxicity in children may not become apparent until the reaction has progressed to tonic-clonic convulsions or cardiac arrhythmias or arrest.[3]

The potential for toxicity is increased when local anesthetics are used in conjunction with sedation medications. Aubuchon surveyed 2911 members of the American Academy of Pediatric Dentistry who use sedation techniques for children.[2] Eleven percent reported that they had observed significant adverse reactions. A near-linear relationship existed between convulsions and the volume of local anesthetic administered. These findings suggest that local anesthetics are a causative agent in precipitating untoward responses.

Goodson and Moore found high drug dosage and drug interaction between sedative medications and local anesthetics to be common elements in 14 cases of severe adverse reactions following pediatric dental sedation.[7] In almost all cases, the dosage of local anesthetic administered was greater than that recommended. These two reports emphasize the potential for toxic reactions in pediatric dentistry due to local anesthetic overdosage.

There are several ways for an anesthetic overdose to occur. Rapid absorption into the blood from highly vascular spaces, or from an accidental intravascular injection, can lead to excessive plasma levels of these agents.[4] However, the greater concern reflected in the literature is that overdosage results from administration of excessive amounts of a local anesthetic agent.

Articaine hydrochloride (Ultracaine; Hoechst, AG, West Germany) is an amide type of local anesthetic derived from thiophene.[5,6] It is available in two formulations: Ultracaine DS Forte (DSF) has 1 : 100,000 epinephrine, and Ultracaine DS has epinephrine 1 : 200,000. Both formulations have been used with adults and children. In adults, it is recommended that the agent should not exceed 7 mg/kg body weight. In children between the ages of 4 and 12 years, it is suggested that doses should not exceed 5 mg/kg. The product monograph also states that articaine has not been administered to children under 4 years of age.[7,8] In fact, articaine has been administered to those under 4 years of age, but its usage has not been documented. The purpose of the present paper is to describe retrospectively the use of articaine in children under 4 years of age.

METHODS

Two pediatric dental offices in London, Ontario, Canada, cooperated to allow an audit of their patient records. The

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records were examined for children under 4 years of age who had received articaine anesthesia with recorded dosages between January 1986 and July 1987.

Two searches were conducted. Initially, patients who had received sedation were identified from appointment books. Group 1 was developed from the records of these children. Only the data for those children under 4 years of age at the time of treatment and who received articaine local anesthetic administrations were used. Each patient's age in months, their sex, weight, the type of administration, type of local anesthetic agent, and volume of local anesthetic were recorded. Medications for sedation purposes were noted. The records were also checked for any observed or reported adverse reactions.

In an effort to document more usage, a second search was conducted of all patient records. These patient records formed the data for Group 2. Again, any child under 4 years of age who received an administration of articaine anesthesia with the dosage recorded between January 1986 and July 1987 was included in the data. Information similar to that gathered in the previous search was obtained; however, the weights for the second group of patients were unavailable—children were not weighed routinely unless preoperative sedation was prescribed.

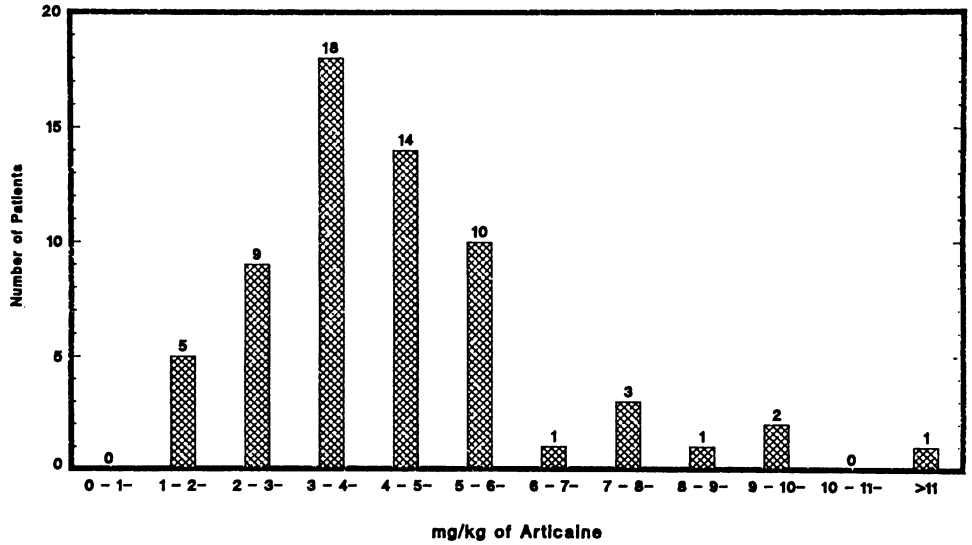
Since the cartridges of articaine are marked with gradations of 0.3 mL, they allow for a fairly accurate reading of the volume administered. Also, each milliliter of the local anesthetic contains 40.0 mg of articaine hydrochloride; thus the concentration of local anesthetic per body weight (mg/kg) was calculated for patients in group 1.

RESULTS

Group 1 consisted of 64 children, 39 males and 25 females, between 12 and 48 months, with a mean age of 32.9 months. Weights ranged from 11 to 20 kg with a mean weight of 14.4 kg ± 2.1. Anesthetic volumes administered ranged from 0.5 to 4.2 mL, with a mean dosage of 1.5 ± .79 mL. The concentration of anesthetic (mg/kg) delivered to the patients is illustrated in Figure 1. Fifty-one (79.7%) of the group reached infiltration injections, five (7.8%) mandibular block injections, and eight (12.5%) had both injection types. All children received preoperative sedation that included chloral hydrate, hydroxyzine hydrochloride, and nitrous oxide-oxygen sedation. The premedicants were at times used by themselves, but most were administered in combinations. Chloral hydrate dosages were from 500 to 1250 mg with a mean 935.9 ± 137.5 mg. Hydroxyzine hydrochloride administrations were 10 to 50 mg with a mean dosage of 22.1 ± 6.1 mg. Nitrous oxide-oxygen sedation was administered to five patients.

Group 2, those children who were not sedated, consisted of 147 patients, 69 males and 78 females; the majority were 42 to 47 months of age. From their medical histories, it was found that three had cardiovascular problems, 11 pulmonary disturbances (usually asthma), three dermatologic problems, and 17 allergies. Six children were following a course of antibiotics at the time of treatment. Twenty-seven mandibular blocks (14.2%), 114 maxillary (60.0%), and 48 mandibular infiltration anes-

Figure 1. The concentrations of local anesthetic administered to sedated children in Group 1.



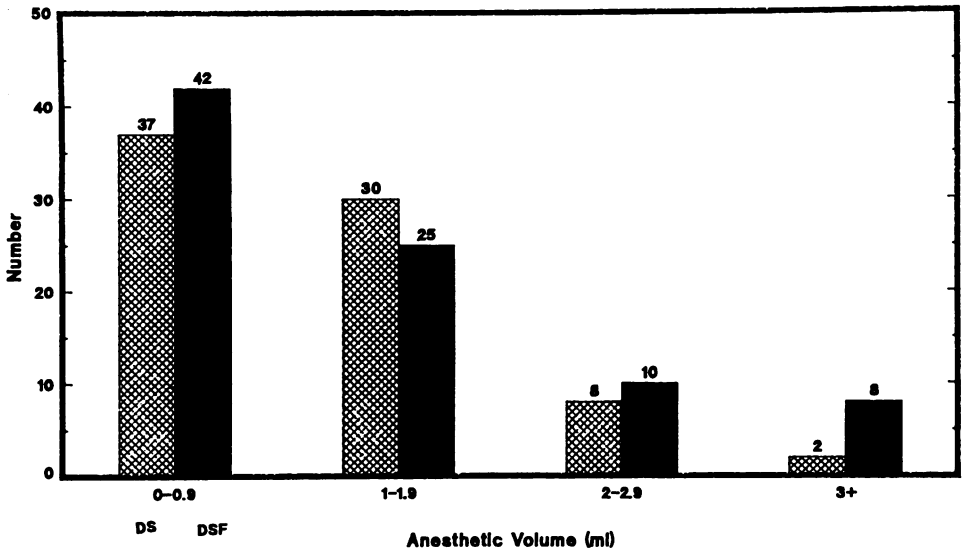


Figure 2. Volumes of local anesthetic that were administered to nonsedated children in Group 2.

thesias (25.8%) were administered. Fourteen children received both infiltration and block anesthesias at the same visit. Interestingly, three patients also received mepivacaine in conjunction with articaine.

Of the 147 patients, 27 had a second treatment session and two others had three appointments each in which articaine hydrochloride was used. The volume of anesthetic administration for each appointment is offered in Figure 2. This included 147 initial administrations and 15 others for children who were still under 4 years of age at succeeding visits.

DISCUSSION

Treating children under 4 years of age for extensive dental caries is not easy; frequently it is desirable to use sedation agents to control behavior and accomplish the treatment as rapidly as possible in a minimum number of treatment sessions. Approximately 80% of pediatric dentists use some form of sedation with selected pediatric patients.[9–11] This usage raises some concern. In Aubuchon's study of adverse reactions during children's sedation experiences, there appeared to be a direct link between adverse reactions and local anesthesia volumes.[2]

Aubuchon recommended administration of minimal amounts of local anesthetic for minimizing adverse reactions.[2] However, this could lead to decreased diffusion and less effective local anesthesia.[12] As a consequence, articaine hydrochloride attracted our attention. Comparing articaine hydrochloride to lidocaine, the potency of articaine is believed to be 1.5 times that of lidocaine and its toxicity is only 0.6 that of lidocaine. Compared to procaine, articaine is 1.9 times more potent and its toxicity is only 0.8 compared to procaine.[6,13] Malamed also notes that the maximum acceptable dosage for lidocaine is 300 mg, procaine 400 mg, and articaine 500 mg.[6] Hence, the potency of the agent along with its apparent greater safety could be important considerations when treating children.

The articaine dosage recommended for children 4 to 12 years of age is 5 mg/kg. In sedated children (Group 1), 18 of 64 subjects actually received concentrations of 5 mg/kg or greater without any adverse effects. It appears then that the concentration of local anesthetic that is recommended for older children could be appropriate for younger ones as well. Five children in this group had dosages in excess of 7 mg/kg. In hindsight, the authors found these levels quite disturbing as they were beyond all child dosage recommendations. Although there were no adverse effects, the audit of charts also demonstrated that greater caution and concern for high local anesthetic dosages is required when planning treatment in sedation cases.

The present retrospective study supports the use of articaine in children under 4 years of age. Considering both groups of children, 211 patients received a total of 240 doses of articaine without any reported adverse effects. These data provide a rationale for a larger, prospective study documenting the efficacy of articaine for pediatric dental patients. This documentation may provide a basis for revising the statement on the manufacturer's product monograph indicating that we have no experience in children under 4 years of age.

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