A survey of local and topical anesthesia use by pediatric dentists in the United States

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Abstract

Purpose: *The purpose of this survey is to evaluate current usage of local and topical anesthesia by Pediatric Dentist to evaluate the current practices.*

Methods: *Surveys were sent to 3051 pediatric dentists asking about types of anesthetics, considerations in determining local anesthetic dosage, time used to inject a cartridge and shortcomings of topical preparations. Data were computed for percentage responses.*

Results: *The response rate was 55%. Only 49% used exact body weight to determine local anesthetic dosage. The mostly commonly used needles for infiltrations were 30-gauge short and blocks were 27-gauge short. Only 11% of the respondents were using ≥60 seconds to inject a full cartridge. Topical anesthetics were used by most, with the most commonly used brand being Hurricane. A third waited 60 seconds before injecting after the application of the topical anesthetic. Most patients (89%) disliked the taste of topical anesthetics and adverse drug reactions were rarely seen.*

Conclusions: *The findings of this study demonstrate that Pediatric Dentists are most commonly using Lidocaine as the preferred type of local anesthetic using 30 gauge short needle for infilterations and 27 gauge short needle for blocks. Most were taking anywhere from 11->60 seconds to inject a cartridge. Topical anesthetic was used by most and the preferred brand was Hurricane,, however their perception of the effectiveness of topical anesthetics varied. There also appears to be a need to develop newer and better mode of topical anesthetic delivery system in the pediatric dental population. (Pediatr Dent 23:265-269, 2001)*

Anesthetic injection is the dental procedure that produces the greatest negative response in children.[1] Pain and anxiety can reduce the efficacy of anesthesia in pediatric patients.[2] This fear of anesthesia is often manifested as a behavior management problem, with a few pediatric patients lacking good coping skills and displaying hysterical behavior in anticipation of discomfort.[3] Anxiety is the most disturbing experience for children,[4] a response that sometimes can only be controlled with techniques beyond local anesthesia.[5]

The proper use of local anesthetic has been reviewed extensively in the literature.[6] However, a recent national survey of 7000 general dentists on the local anesthetic usage concluded that the present inferior alveolar nerve block techniques may increase the chances of anesthetic overdose .[7] Intravascular injection is one of the complications of local anesthetics in children with the highest incidence seen associated with the inferior alveolar nerve block.[8] Anesthetic overdose reactions are related to the blood levels being above the overdose threshold levels in the injected site. There are several factors that can predispose a patient to this overdose of anesthetic. The patient factors include age, weight, other medications, sex, presence of other systemic disorders, genetics and mental attitude and environment. Drug factors that can contribute to the anesthetic overdose include vasoactivity, concentration, dose, route of administration, rate of injection, vascularity of the injected area and presence of vasoconstrictors. Several of these factors can be eliminated without having to modify the procedure and they include using the minimal drug concentration that would be clinically adequate.[9] Malamed recommends aspiration be performed prior to injection to prevent depositing a large amount of anesthetic into the circulatory system.[10] The rate of the injection is one of the most important factors to prevent drug overdose. A slow rate of injection taking 60 or more seconds to inject a full cartridge of anesthetic can ensure that the anesthetic is safe and clinically adequate.[9] However, it is not known what percentage of clinicians is utilizing this technique.

Topical anesthetics can also contribute to this drug overdose. Systemic toxic reactions associated with a topical anesthetic are virtually unknown for the most commonly used topical anesthetic agents like benzocaine.[10] Lidocaine-based topical anesthetics are basically vasodilators and are used in stronger concentrations; they are rapidly absorbed into the systemic circulation when applied to the oral mucous membrane.[11] It is recommended that the amide topical anesthetic be applied sparingly only to the area of needle penetration to gauze-dried oral mucous membrane.[10] The benzocaine (ester) topical anesthetics are less likely to cause an overdose as they are poorly absorbed into the cardiovascular system, if at all.[10] Malamed recommends that a sparing amount of amide topical anesthetic be used, but the ester topical anesthetic in small amounts can be used with minimal likelihood of overdose.[11]

Age and weight can be variables that are critical for the safety of the pediatric population, it is imperative to reinforce the recommendations of Malamed to prevent anesthetic overdoses. [9]

Received March 16, 2000 Revision Accepted December 22, 2000

Table 1. Local Anesthetic Results

1. What **type** of local anesthetic drug do you use most often?	
a. Lidocaine	83%
b. Mepivacaine	11%
c. Bupivacaine	0%
d. Prilocaine	5%
e. Other	1%
2. What is the most important **factor** that you consider when you decide on dosage of the local anesthetic that you will inject?	
a. exact age in years	2%
b. exact body weight	49%
c. estimated size of the child	44%
d. others :	5%
3. What **gauge** of needle do you use most often?	
a. *infiltration* :	
1. 25 gauge	4%
2. 27 gauge	36%
3. 30 gauge	60%
4. other	0%
b. *blocks* :	
1. 25 gauge	7%
2. 27 gauge	53%
3. 30 gauge	40%
4. other :	0%
4. What **length** of needle do you use most often?	
a. *infiltration* :	
1. long	3%
2. short	84%
3. ultrashort	13%
4. other :	0%
b. *blocks* :	
1. long	21%
2. short	78%
3. ultrashort	1%
4. other :	0%
5. How much **time** do you take to inject a full cartridge?	
a. ≤10 sec	2%
b. 11-20 sec	25%
c. 21-30 sec	29%
d. 31-60 sec	33%
e. ≥ 61 sec	11%

There are several recommendations made by Malamed when using local and topical anesthesia in the pediatric population. It is not known what percentages of the practicing pediatric dentists are following these recommendations. There is a need to assess the current practices in order to inform and educate the practitioners to prevent fatal anesthetic overdoses in children. This survey will help make recommendations, if any, on the need for a newer and better mode of topical anesthetic delivery systems in Pediatric Dentistry.

Methods

Confidential surveys were sent to 3057 pediatric dentists in the United States who were members of the American Academy of Pediatric Dentistry in 1997, with a cover letter and a self-addressed return envelope. The return envelopes were coded for tracking purposes only and for second mailing purposes if needed. The survey included questions relating to the use of local and topical anesthetics utilized, the adverse drug reaction to the use of anesthetics, the length of time used to inject a cartridge, the needle size and gauge commonly used for infiltrations and blocks, factors used in determining the dosage (Table 1). The survey also asked the clinicians what percentage of the times a topical anesthetic was used prior to the injection; the most commonly used preparation of topical anesthetics; waiting time after the application of topical anesthetic before injecting; if the practitioner considered the topical anesthetic effective; if the practitioner would consider a different delivery system for the topical anesthetic; what his/her patients most disliked about the topical anesthetic; what percentage of the patients had an adverse drug reaction to the topical anesthetic in the last year, and, if so, to briefly describe the adverse drug reaction (Table 2). The survey also asked the clinicians to provide demographic data such as the size of the community and their year of graduation. Data was analyzed by computing the percentage response for each question.

Results

The return response rate of this survey was 55%. As for the demographic data, 27% of the respondents graduated between the years of 1987-1997, 30% graduated between the years of 1977-1986, 31% graduated between the years of 1967-1977, and 12% had more than 30 years of practice experience. Thirty percent of the practitioners practiced in communities that had a population of 101,000-500,999; 21% practiced in communities sized 51,000-500,999; 15% practiced in communities larger than 1,000,000; 12% practiced in communities of 600,000-1,000,000; and 11% practiced in communities of 31,000-50,999. The remaining practiced in communities smaller than 31,000 people.

The responses for local anesthetic are tabulated in Table 1. Lidocaine was one of the most commonly used local anesthetic (83%), followed by mepivacaine (11%). Five percent reported using prilocaine, and none reported using bupivacaine. One percent of the respondents reported using diphenhydramine as a local anesthetic agent.

When questioned which criteria practitioners used to determine the local anesthetic dosage, almost half of the respondents (49%) reported using the exact body weight when determining the dosage of local anesthetic for each pediatric patient. Estimated size of the patient was used by 44%, while 2% used the patient's age, and 5% used other methods such as "all patients receive one cartridge"; "degree of difficulty of procedure"; "length of treatment"; "number of teeth needing to be treated"; and "degree of carious involvement". A few practitioners used no criteria to determine the dose, while a few used the dose needed to achieve profound anesthesia. A few respondents reported that the medical history of the patient or the type of treatment determined the dosage needed by the patient.

The commonly used gauge sizes by the practitioners showed that 60% of the respondents preferred the use of a 30 gauge, 36% used a 27 gauge and 4% used a 25 gauge for anesthetic infiltrations. For blocks, the most commonly used gauge size was a 27 gauge (53%) followed by a 30 gauge (40%). Only 7% of the respondents were using a 25 gauge for this injection. Most of the respondents (84%) were using a short needle, whereas 13% used an ultra-short needle and 3% were using a long needle for infiltrations. The most commonly used length of needle for blocks was the short needle (78%), followed by the long needle (21%) and 1% used the ultra short needles.

When questioned regarding the amount of time taken to inject a full cartridge of local anesthetic, 2% took less than 10 seconds, 25% took 11-20 seconds, 29% took 21-30 seconds, and 33% took 31-60 seconds. Only 11% took 61 seconds or more for the injection.[12]

The responses for the topical anesthetics are tabulated in Table 2. The respondents' responses to the question regarding the use of topical anesthetics, a majority of the respondents (86%) always used a topical anesthetic while 9% sometimes used a topical anesthetic. Only 4% reported that they rarely used topical anesthetic with 1% reporting that they never used a topical anesthetic.

As for the preference of topical anesthetic, 41% preferred Hurricane® (Beutlich, L.P., Waukegan, IL), followed by Topicale® (Premier Dental, King of Prussia, PA) (15%), followed by lidocaine (12%) and finally Xylocaine (3%). About a third of the respondents (29%) used some other form of topical anesthetics, such as a generic brand.

When the respondents were asked about the length of wait before injecting, 4% waited less than 10 seconds, 30% waited 11-30 seconds, while 33% waited 31-60 seconds, and 33% waited 61 seconds before injecting.[10]

When asked about the effectiveness of topical anesthetics, 23% perceived them very effective, 38% effective, 29% adequate, 9% poor, and 1% perceived them ineffective.

The survey also asked if the respondents would consider a different topical anesthetic delivery system. A majority of the respondents (71%) would consider a different topical anesthetic, while 24% were undecided on this issue, and only 5% had no desire to consider a different delivery system.

When questioned concerning the different properties of topical anesthetic, most patients did not like the taste (90%), consistency was not favored by 2%, with 8% reporting complaints by patients including burning, numbness of the entire mouth and inability to swallow.

The adverse drug reactions to topical anesthetics seen in the last year of practice were also examined. Most of the practitioners (98%) reported that their patients did not experience any adverse reactions to the topical anesthetic, while 2% of the practitioners reported that 1-3% of their patients experienced an adverse drug reaction to the topical anesthetic which included allergic reactions including angioedema and urticaria, "red-dye allergies", and "allergy to the strawberry flavor", nausea and methemoglobinemia.

When practitioners were asked the percentage of times they felt that the topical anesthetic worked, 14% felt that the topical worked 100% of the times; 42% felt that it worked 75% of the times; 28% felt it worked 50% of the times; 14% felt that it worked only 25% of the times; and 2% felt that it never worked.

Table 2. Topical Anesthetic Results

1. Do you use any topical anesthetic gel, etc.?	
a. always	89%
b. sometimes	9%
c. rarely	4%
d. never	1%
2. What **brand** of topical anesthetic do you use?	
a. Hurricaine	41%
b. Lidocaine Gel/Ointment	12%
c. Topicale	15%
d. Xylocaine	3%
e. Other :	29%
3. How long do you **wait** after applying a topical anesthetic before you inject?	
a. ≤10 sec	4%
b. 11-30 sec	30%
c. 31-60 sec	33%
d. ≥ 61 sec	33%
4. Do you think topical anesthetics are **effective** when applied prior to the local anesthesia injection?	
a. Very effective	23%
b. Effective	38%
c. Adequate	29%
d. Poor	9%
e. Ineffective	1%
5. Would you consider using a **different delivery system** of topical anesthetic preparation if available in the market?	
a. Yes	71%
b. No	5%
c. Undecided	24%
6. What do your patients most **dislike** about the topical anesthetic available in the market today?	
a. Taste	90%
b. Consistency	2%
c. Color	0%
d. Smell	0%
e. Other:	8%
7. How many of your patients experienced any **adverse drug reaction** to the **topical** anesthetic preparation in the last year?	
a. 0 %	98%
b. 1-3%	2%
c. 4-6%	0%
d. ≥7%	0%
8. In your experience treating pediatric patients, approximately what percentage of the times do topical anesthetics work when applied prior to the local anesthetic injection?	
a. 0%	2%
b. 25%	14%
c. 50%	28%
d. 75%	42%
e. 100%	14%

Discussion

The response rate of 55% in this survey was significantly better than those that obtained from a national survey on inferior alveolar blocks that had a response rate of only 20%. [7] The sample that was surveyed for this study represents pediatric dentists with various levels of clinical experience: 27% had less than 10 years experience in practice, 61% had 10 to 30 years experience in practice and 12% had more than 30 years experience in practice.

With the question of the factor used to determine the dosage of local anesthetic, the survey question was flawed that it should have been reworded to read as what is the factor used to determine the maximum dosage. Malamed recommended the use of exact body weight to prevent anesthetic overdose. In the present sample, 51% were using estimated body weight, age of the child or some other factor to determine the anesthetic dose. It is possible that clinicians are not determining and not necessary to determine the maximum dosage if one cartridge or less of anesthetic was being used for a single quadrant in a school-aged child.

In regards to the use of 25 gauge needles, the survey showed that a high percentage of pediatric dentists are using needles with a diameter smaller than recommended. Malamed recommends the "use of a 25 gauge needle for all injections in highly vascular areas and 27 gauge needle can be used for all other injection techniques provided the aspiration percentage is ex-

ceedingly low". [13] Trapp and Davies have reported positive aspiration through 23-, 25-27- and 30-gauge needles.[1] However, the question as to which is the appropriate needle gauge remains and it is universally agreed upon that the anesthetic solution must be injected slowly and the dentist should observe the patient carefully for any unexpected reactions.[1] Malamed also recommends the length of the needle to be "long for all techniques requiring penetration of significant thickness of soft tissue. Short needles may be used for injections that do not require the penetration of significant depths of soft tissue".[13] If using a smaller diameter is justified to prevent visual excitation of the patient, it must be noted that the diameter difference is almost negligible to the unaided eye.[13]

As for the time taken to inject a full cartridge of anesthetic, a slow injection is important for two reasons: 1) for the safety of the patient and 2) to prevent the solution from tearing the soft tissue into which it is being injected. Rapid injection causes an immediate discomfort that last a few seconds followed by a prolonged soreness long after the numbing effect of the local anesthetic has subsided.[10] Malamed recommends at least 60 seconds for a full 1.8ml of cartridge as this rate of deposition will not produce tissue damage either during or after anesthesia, nor will it cause a serious reaction in an event of accidental intravascular injection.[10] Eighty-nine percent of the surveyed pediatric dentists were injecting a full cartridge with a time of less than sixty seconds.

As for the length of wait after application of topical anesthetics, Hurricaine® manufacturers recommend waiting 10-30 seconds before injecting depending on the form of the preparation while manufacturers of Xylocaine, recommend waiting several minutes before injecting. Malamed recommend 60 seconds or longer before injection to assure maximum efficacy of topical anesthetics.[10] Others recommend a wait of approximately 30 seconds[1]. There seems to be a lot of confusion in the literature related to the usage and wait times of topical anesthetics and more research in this area is needed. Most practitioners responded that the current topical anesthetics they were using in their offices were effective, while about 10% thought they were inadequate. The fact that 1% of them perceived topical anesthetics to be ineffective is consistently with the fact that 1% of the respondents reported that they never used topical anesthetics. Most practitioners responded that their patients disliked the taste, consistency and the warm/burning sensation of the topical anesthetics.

In the surveyed sample, 71% preferred an alternate means of delivery of topical anesthetics. Research is in progress to evaluate new topical anesthetic preparations. One study addressed the use of EMLA® (lignocaine-prilocaine) cream in preparing pediatric patients for venepuncture, but it is not known if this cream will be effective intraorally in dentistry.[14] A more recent study evaluated the efficacy of the commonly used topical anesthetics and found that EMLA was very effective as an intra-oral topical cream[15]. Several researchers have looked into other delivery systems of both the topical and local anesthetics. Two recent studies evaluated the analgesic efficacy and safety of an intraoral lidocaine transoral delivery system (DentiPatch®, Noven Pharmaceutical, Inc., Miami, FL) and concluded that the patch achieved significant analgesia while demonstrating ten to fourteen times lower blood levels, as well as being effective in reducing the pain experienced during needle insertion.[16,17] However, product description published by Noven Pharmaceuticals, Inc. does not recommend the DentiPatch, for use in patients under the age of twelve. Other pain control possibilities include the use of hypnosis and electronic devices.[18]

In this survey, very few practitioners reported any major complications from the local and topical anesthetics. However, deaths due to local anesthetics have been reported in the literature and are mainly due to anesthetic overdoses.[19] Intravascular injections can also cause higher incidence of local anesthesia toxicity, which can be compounded by the use of topical anesthetics that adds to the total dose of local anesthetic used.[11] A recent study demonstrated an increased chance of local anesthetic overdose during infra-alveolar blocks among practicing dentists.[7]

Conclusion

The findings of this study demonstrate that Pediatric Dentists are most commonly using Lidocaine as the preferred type of local anesthetic using 30gauge short needle for infilterations and 27 gauge short needle for blocks. Most were taking anywhere from 11->60 seconds to inject a cartridge. Topical anesthetic was used by most and the preferred brand was Hurricane,, however their perception of the effectiveness of topical anesthetics varied. There also appears to be a need to develop newer and better mode of topical anesthetic delivery system in the pediatric dental population.

The authors would like to thank Dr. Stanley Wearden for help with the analysis of the data, Emmy Lewis for her editorial help and University Health Associates for funding this project. A University Health Associates Grant supported this study.

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Abstract of the Scientific Literature

Improved Sealant Retention with Use of Bonding Agents

The results from recent in vitro studies have suggested that adhesion of pit and fissure sealants to saliva-contaminated enamel is improved when bonding agents are applied to the etched surface prior to sealant application. The purpose of this five-year clinical study was to assess the effect of bonding agents on the success of occlusal and buccal/lingual sealants. In this study, each patient received sealants on 4 molars; 617 occlusal and 441 buccal/lingual molar sealants were evaluated. In the split-mouth design used in this study, 1 maxillary and 1 mandibular molar was randomly selected to receive a normal sealant while the opposite molar in each arch received a bonding agent plus sealant. Fluoroshield sealant (Dentsply/Caulk) was used and sealant application was completed as per manufacturer's instructions. The following components from fourth-generation dentin bonding systems were tested: Tenure primer (Den-Mat), Scotchbond Multipurpose primer (3M Dental Products). The following fifth-generation bonding systems were tested: Prime & Bond (Dentsply/Caulk), Single Bond (3M), and Tenure Quik (Den-Mat). Moisture control was accomplished using cotton-roll-isolation procedures. Sealant retention was improved when the fifth-generation, single-bottle adhesive systems were applied to the etched enamel prior to application of the sealant. The components from the fourth-generation bonding systems did not provide a similar protective effect.

Comments: The risk of failure for occlusal sealants was reduced by one-half and the risk of failure for buccal/lingual sealants was reduced by one-third when fifth-generation one-bottle bonding agents were applied to the etched enamel prior to sealant application. **PS**

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Feigal RJ, Musherure P, Gillespie B, Levy-Polack M, Quelhas I and Hebling J. Improved sealant retention with bonding agents: A clinical study of two-bottle and single-bottle systems. J Dent Res 79(11): 1850-1856, 2000.

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