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Safety review on Local and Injectable Anesthesia used by Dental hygienists

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Abstract: Local anesthesia is possibly the most important aspect of oral surgery practice. Without it, none of the surgical procedures discussed in this issue would have been possible. Local anesthetics have made a great advancement in dentistry and have changed patient's perspectives of dental procedures to a great extent. There is still room for the improvement of painless techniques in administrating local anesthetics. It is important for clinicians to be familiar with all the local anesthetics available for dental procedures, their mode of action, and their adverse reactions and how to treat them. This article has given an overview of local anesthetics, topical anesthetics, safety review, commonly occurring and known complications associated with local anesthesia and possible treatment modalities.

Keywords: Anesthesia, Local anesthetics, Injectable anesthetics, Complications

Introduction:

Local anesthesia is a reversible blockade of nerve conduction in a circumscribed area that produces loss of sensation. The chemical agents used to produce local anesthesia stabilize neuronal membranes by inhibiting the ionic fluxes required for the propagation of neural impulses. Today's anesthetics are safe, effective, and can be administered with negligible soft-tissue irritation and minimal concerns for allergic reactions. Indeed, no aspect of office oral surgery is as important as good pain control. Excellent local anesthesia permits the dental

surgeon to perform the necessary surgical procedure in a careful, unhurried fashion that will be less stressful for both the operator and the patient. The achievement of good local anesthesia requires knowledge of the agents being used, the neuro anatomy involved, and adherence to good techniques.[1]

Local anesthesia can be achieved by infiltration (field anesthesia) or by conduction anesthesia (nerve block). For maxillary surgical procedures, in the vast majority of cases infiltration anesthesia is all that is required because the cortical plate of the alveolus of the upper jaw is almost always thin and porous enough to make infiltration anesthesia effective. Procedures on the lower jaw will most often require nerve block anesthesia of the inferior alveolar, lingual, and buccal nerves.[1]

Within the last 30 years, many states have expanded the scope of practice for dental hygienists to include the administration of local anesthesia.[2, 3] Several studies have been performed to assess practice characteristics and effectiveness of these changes in state licensure regulations. Findings indicate an acceptance of this expansion in dental hygiene practice, with prominent rates of employer delegation of local anesthesia administration to dental hygienists, successful injection administration, and positive benefits to dental practice.[4] Although these various outcomes support the use of this modality by dental hygienists, the delegation of these pain control procedures remains controversial.[2, 5, 6]

As demonstrated in Table 1, the UPDHLI survey also determined the type of local anesthetic injections used by the respondents administering local anesthesia (n 5 257). The questions were grouped into four categories: infiltration/supraperiosteal injections, nerve block injections, field block injections, and topical anesthetic applicationwithout injection. The results demonstrated that nerveblock injections (two to three times perweek) and infiltration/ supraperiosteal injections (two to three times per week) were the most commonly administered injection techniques while field block injections (one to two times per week) were administered by the respondents with lesser frequency. It should be noted that the survey also determined that topical anesthetic (ie, Oraqix) application without injection was the most common form of

local anesthesia to be employed by those administering injections. Higher frequency of topical anesthesia use is likely relatedto the fact that topical anesthetics may sometimes be used as a substitute to injectable anesthesia (ie, long buccal and palatal injections), which can be distressing for the patient but necessary for quadrant management.[4]

Table 1:

University of Pittsburgh Dental Hygiene Local Anesthesia Initiative Survey: mean distribution of local anesthetic injection type used according to the dental hygiene respondents main practice activity[a]						
Local Anesthesia Modality	Total Response (n 5 257)	Periodontal Setting	Public Health Setting	Academic/ University Setting	General Dentistry Setting	Pediatric Setting
Infiltration injection	2.02	2.87	2.33	1.62	1.64	0.75
Nerve block injection	2.12	2.38	1.64	2.25	1.72	0.67
Field block injection	1.52	2.06	1.64	2.25	1.15	0.67
Topical anesthesia without injection	2.38	2.65	2.17	2.62	2.09	1.75

[a] The respondent was asked to select a single numeric answer for the amount of each local anesthesia modality performed from the choices: 0, never (0); 1, rarely (1–2 times per week); 2, occasionally (2–3 times per week); 3, often (4-5 times per week); 4, most often (more than 5 times per week).

The safety of local anesthesia administration by dental hygienists also has been

substantiated through the lack of reported disciplinary actions. No formal complaints associated with local anesthesia administration against dental hygienists were known to state dental boards or American Dental Hygienists' Association constituent presidents based on surveys reported in 1990 and again in 2005.[7, 8] The Synopsis of local anesthesia administration safety and efficacy studies with dental hygienists are given bellow in table 2

Table 2:

Synopsis of local anesthesia administration safety and efficacy studies with dental hygienists		
Category	**Subject**	**Findings**
Safety	Aspiration safety protocol	86% of responding hygienists reported the use of consistent aspiration before injection; 7% reported the use of aspiration most of the time, and 3% reported infrequently aspirating before injection[4]
Safety	Complication rates	87.8% of dental hygienists signified no complications when administering local anesthesia injections[4]
Efficacy	Self-reporting of success	76% of surveyed dental hygienists reported successful anesthetization 90%–100% of the time, and 16% reported success 75%–89% of the time[4]
Efficacy	Employer/dentist observer ratings	Dentists (n 5 57) identified a benefit to both their practices and their patients as a result of the administration of local anesthesia by their dental hygiene employees; the mean percentage of agreement with this statement was reported at 80.4%[9]
Efficacy	Employer/dentist observer ratings	92% of dentist employers were satisfied with their dental hygienists' ability in administering local anesthesia injections[10]
Safety	Complication rates	Out of 19,849 anesthetizations by dental hygienists, only three cases of temporary paresthesia were identified[11]
Efficacy	Success rates	Out of 19,849 injections performed by dental hygienists, a success rate of 96.7% with infiltrations and an 85.7% success

		rate with nerve block techniques were found with dental hygienists[11]
Safety/ Efficacy	Continued delegation of anesthesia administration to hygienists	100% of periodontists and 86% of general dentists delegated the administration of local anesthesia to dental hygienists based on this survey of California dental hygiene graduates[12]
Safety	Disciplinary reports	No formal complaints associated with local anesthesia administration against dental hygienists were known to state dental boards or American Dental Hygienists' Association constituent presidents based on surveys reported in 1990 and again in 2005[7]
Efficacy	Adequacy of anesthesia with dental hygiene students	Through evaluations completed by restorative dentistry and periodontics faculty, it was determined that out of 3926 injections administered by dental hygiene students, adequate anesthesia was achieved 95% of the time[13]

Topical Anesthetics Agents:

Topical anesthetics are substances that can cause surface anesthesia of skin or mucosa. In dentistry these agents are used to temporarily anesthetize the tiny nerve endings located on the surfaces of the oral mucosa, with the aim of reducing the discomfort of dental injections and other minimally invasive procedures. The agents are supplied in various forms—gels, ointments, sprays, and solutions—and can be obtained in flavors such as strawberry, mint, cherry, banana, and bubble gum. The concentrations of topical anesthetic solutions are higher than those of injectable anesthetics but take longer for the full effect in comparison with the injectable anesthetics. In general, 1 to 5 minutes of contact time is required for topical anesthetics to reach their full effectiveness (up to 2–3 mm from the surface) so patience is required on the part of the dentist. For maximum effectiveness, the area of the mucosa where the topical anesthetic is to be placed should be dry.[14]

Combination topical anesthetics: Compounding is the process by which drugs are combined or the ingredients altered to create a custom-made medication. In the case of topical anesthetics the aim is to produce a strong topical anesthetic that can be used for minimal to moderately painful procedures. These preparations contain higher concentrations of topical anesthetics, making them stronger and capable of maintaining their efficacy for longer durations after application.

These combination preparations of local anesthetics are commonly referred to as eutectic mixtures of local anesthesia (EMLA). When mixed together in certain ratios they form a "eutectic mixture" in which the melting point of the mixture is lower than the melting point of the individual components. This blending allows the mixture to be more in a liquid state that will allow the agents to be better absorbed through the oral mucosa.[14]

Local anesthetics exist in both an ionized (cation) and un-ionized (base) form. The un-ionized form of local anesthetic can pass through the nerve membrane and take effect. During infection, local tissue becomes acidic and therefore anesthetic remains mainly in cation (ionized) form. Mepivacaine has a higher pH than lidocaine; therefore when it is used in an acidic environment it has more base form and thus will pass through nerve membrane, and is more effective. This characteristic makes mepivacaine a good choice of local anesthetic when there is infection.[15] Table 3 gives a more complete list of topical anesthetic agents.[14]

Table 3:

Topical anesthetics		
Trade Name	**Composition and Form**	**Flavor**
CaineTips	Individually wrapped, disposable swabs prefilled with 20% benzocaine	Cherry flavored
Comfortcaine	20% benzocaine	Available in 6 flavors
Gingicaine	20% benzocaine	Available in 7 flavors
Hurricaine	20% benzocaine in gel and liquid formulations	Gel is available in 4 flavors and liquid in 2 flavors

LolliCaine	20% benzocaine gel on a single-use clean swab applicator	Available in 3 flavors
Topex	20% benzocaine	Available in 7 flavors
Cetacaine	Benzocaine 14%, aminobenzoate 2%, and tetracaine 2%. Spray	
One Touch	18% benzocaine and 15% tetracaine as a gel	Available in 5 flavors
Profound	Tetracaine, lidocaine, and prilocaine as a gel	

Injectable Anesthetics:

As a local anesthetic is characterized by a rapid onset of action and intermediate duration of efficacy, making it suitable for infiltration and nerve block anesthesia, and the "perfect" local anesthetic for dentistry. lidocaine (Lidocaine hydrochloride) is the first amino amide type of more potent local anesthetic, and has been in use for more than 60 years. It is considered as the prototype for amide local anesthetics, and is very familiar to dentists Table 4 gives a more complete list of injectable anesthetic agents.[16]

Table 4:

Injectable local anesthetics		
Short Acting	**Intermediate Acting**	**Long Acting**
Lidocaine 2% 30–45 min	Mepivicaine 3% 90–120 min	Bupivacaine 0.5% with epinephrine 1:200,000 240–720 min
	Prilocaine 4% (nerve block) 120–240 min	
	Prilocaine 4% (infiltration) 60–120 min	
	Articaine 4% with epinephrine	

	1:200,000 180–240 min	
	Mepivicaine 2% with epinephrine 1:200,000 120–240 min	
	Lidocaine 2% with epinephrine 1:50,000 180–300 min	
	Lidocaine 2% with epinephrine 1:100,000 180–300 min	
	Mepivicaine 2% with levonordefrin 1:20,000 180–300 min	

Complications:

Allergic Reactions- When exposed to an antigen, the immune system is triggered to produce a hypersensitivity reaction or an allergic reaction. Most allergic reactions are minor but will depend on the person's immune system response, which is sometimes unpredictable. In rare cases, an allergic reaction can be life threatening (anaphylaxis). Symptoms and signs of an allergic reaction may include any or some the following: skin irritation with itching and swelling, welts or bumps on the face and neck, stuffy or runny nose, wheezing, shortness of breath, and headaches.

Postinjection Pain and Trismus- Persistent pain at the site of injection is the most common complication of local anesthesia in the oral cavity. Some causes of the pain are multiple injections in a short period of time, injection into the belly of one of the adjacent muscles, or muscle tears from too forceful injections.

Trismus is also a relatively common complication following local anesthetic administration. Several factors may play a role in causing the trismus. Injection into the temporalis, masseter, or medial pterygoid muscles may damage the muscle fibers and cause limitations in opening. The most common muscle to be the source of trismus

is the medial pterygoid, which can be penetrated during an inferior alveolar nerve block. Trismus occurring 2 or 3 days after the injection is most likely a needle tract infection, and should be treated with antibiotics.

Facial Nerve Paresis- Facial nerve (cranial nerve VII) gives motor innervations to the muscles of facial expression. The nerve exits the skull from the stylomastoid foramen. After exiting the foramen it enters the parotid gland, divides, and exits the parotid as 5 major branches. Facial nerve paralysis can occur if local anesthetic is injected close to the "deep lobe" of the parotid. This paralysis can occur if during administration of local anesthetic for inferior alveolar nerve block the needle goes posterior and the anesthetic solution is deposited within the substance of the parotid.

Broken Needle- Local anesthetic needle breakage is rare and because there are few reports, the mechanism and best treatment options are undetermined. The vast majority of cases (94%)21 of broken needles occurs in connection with an inferior alveolar nerve block, often with 30-gauge needles. Incidents of broken needle are associated with prior bending of the needle, unexpected patient movement, and defective needles.[1, 17]

Lingual Nerve Injury- Anesthesia, paresthesia, or dysesthesia of the lingual nerve occur on rare occasions with inferior alveolar nerve blocks. Although both the inferior alveolar and lingual nerves can be damaged during an attempted inferior alveolar nerve block, most studies show that it is the lingual nerve, rather than the inferior alveolar nerve, that is predominantly affected and that the lingual nerve may be affected in up to 80% of cases.12 Pogrel and colleagues believe that the lingual nerve may be predominantly affected because of its fascicular pattern.[18, 19]

Conclusion:

This literature review confirms patient and dentist satisfaction with dentist providing local and Injectable anesthesia. With the preponderance of dentist reporting a need for this modality, this practice appears to be a substantial addition to total dental care.

Taking into account the consistent record of safety and success with local and Injectable anesthesia administration by dentist documented in the reviewed studies and the existing evidence of overall benefit to dental

practices through increased patient comfort and improved practice workflow continued support for the delegation of local and Injectable anesthesia administration to dentist.

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