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Don't Be Numb to Local Anesthesia Risks

It has been estimated that American dentists administer hundreds of millions of local anesthetic injections each year.[1] Because of their common occurrence and relative safety, local anesthetic injections are often overlooked as a professional liability risk. While not a significant source of professional liability claims, adverse events can occur during and in response to local anesthetic injections, sometimes with serious consequences.

The allegations seen most frequently in such claims are an improper injection technique, an improper choice of anesthetic, or an excessive dose caused the claimed injury. The alleged injuries range from temporary effects, such as fainting and partial paresthesia, to irreversible outcomes such as permanent anesthesia and death from anesthetic toxicity.

It is understandable that a common procedure with a relatively low incidence of reported claims may lead a dentist to become complacent about its risks. Nevertheless, local anesthetic agents are the only drug that most dentists will ever inject into a patient. As drugs, they require a continued diligence regarding their use, risks, and management of adverse responses. We recommend that dentists and all auxiliary personnel licensed to administer local anesthetic injections keep abreast of current information regarding drug use and dosing information. There are a number of references and texts, as well as periodical articles, that can provide a more detailed and technical discussion of the subject.

The adverse responses associated with local anesthetic agents vary greatly in their severity and impact on a patient's life. Keep in mind that your ability to respond to an adverse event is just as important a risk management skill as your ability to prevent an adverse event from happening. Fortunately, the most common occurrences are also the least severe and among the most basic to manage.

Adverse Systemic Responses

There are many factors that affect a patient's risk of an adverse systemic response to local anesthesia. They include aspects of the anesthetic, such as dose, concentration, and vasoconstrictor presence or absence. Patient characteristics such as regional anatomy, hepatic and renal health, current medications, and level of anxiety are critically important. Certainly, clinician-controlled factors make a difference, too, including the anesthetic agent selected, the thoroughness of the medical history review, the speed of injection, and the clinician's technique.

Syncope. Many patients consider local anesthesia injections to be a stressful procedure. As a result, anxiety-induced events are the most common type of adverse systemic response.[1] Frequent symptoms include palpitations, hyperventilation, nausea, vomiting, and a fainting feeling, often leading to syncope. Syncopal events typically resolve in a short period of time with no lasting effects.

Dentists should exercise preventive measures in managing anxious patients and those with a history of fainting. Suggest that patients loosen tight clothing like collars and neckties. Unbuttoning the cuffs of shirt sleeves may also promote patient comfort. Since syncope is due to a period of cerebral ischemia, it is advisable to position patients with their feet slightly higher than their brain (about a 10 to 15 degree angle), thus promoting adequate cerebral blood flow. However, this cannot always be accomplished due to the need to properly position the patient for the injection being given. You can also suggest that

patients move their arms and legs prior to the injection to reduce peripheral blood pooling in the musculature and precluding its flow to the brain.

If a patient does faint, your first step should be to position the patient in a supine position with the feet slightly elevated. Then check for adequate breathing by listening for exhaled air and watching for chest movement. Most patients continue breathing after fainting. However, artificial respiration may be necessary in some cases. Circulation should be assessed by taking the carotid pulse. Once the airway, breathing, and circulation are confirmed, you can take additional steps, such as placing the patient on oxygen and monitoring vital signs. You may also choose to use an ammonia vaporole to stimulate increased breathing and movement of the extremities.

If patient has not recovered in approximately 15 minutes, contact your local EMS provider. It may be that syncope was not the cause of the patient's loss of consciousness. One additional important consideration is that healthy children do not faint. If a child appears to be fainting, activate EMS immediately.

Overdose. A less frequent occurrence but one of much greater concern is anesthetic overdose. High blood levels can be caused by a number of factors, including a single inadvertent intravascular injection, repeated injections, and rapid absorption in the absence of a vasoconstrictor. Local anesthetic agents are both central nervous system and cardiovascular depressants. Toxic levels of local anesthesia will affect the brain first, then the heart. The brain (CNS) is more sensitive to local anesthetics than are peripheral nerves, and local anesthetics readily cross the blood-brain barrier. Also, be aware that opioid analgesics are additive with local anesthetics in central nervous system depressive activity. This fact is of particular concern in cases involving pediatric sedation with opioids, during which local anesthetic doses should be adjusted downward.[2]

Signs of mild overdose usually develop between 5-10 minutes after injection, but may take longer. There may or may not include an excitatory phase exhibited by talkativeness and excitability. Symptoms include anxiety, restlessness, dizziness, sedation, analgesia, slurred speech, euphoria, sweating, vomiting, elevated heart rate, and elevated respiratory rate.

A more severe overdose may manifest itself rapidly – in a minute or so – or may take up to 15 minutes. Characterized by depression of the central nervous system, severe overdose results in symptoms such as disorientation, seizure activity, respiratory depression, and unconsciousness. Higher concentrations are required to depress cardiac muscle function, leading to a mild decrease in blood pressure, reduced cardiac output, or even cardiac arrest and death.

Because of the potential severity of injuries associated with local anesthesia overdose, prevention is the most prudent risk management technique. Keep the following recommendations in mind to minimize your risk of administering an overdose of local anesthetic.

- Review the patient's medical history, with particular attention to liver and kidney function. The liver biotransforms anesthetic and the kidney excretes it. A patient with reduced hepatic function is predisposed to toxic effects, therefore it is prudent to reduce the maximum anesthetic dose for individuals with liver or kidney dysfunction.

- Aspirate before injecting. Intravascular injections cause the quickest and most profound effects. In his book *Handbook of Local Anesthesia* (Fourth Edition, Mosby, 1997), Malamed reports that positive aspiration occurs in 10-15% of inferior alveolar block injections.[3] An adverse effect can occur within 1 minute of an intravascular injection.

- Inject slowly. An entire 1.8 ml cartridge should take about 60 seconds to inject. Should your needle happen to be intravascular, the rapid intravenous administration (less than 15 seconds) of a full cartridge significantly increases the risk of an overdose reaction.[3]

- Keep the dosage *below* the recommended maximum. It can be easy to lose track of the total number of cartridges given over an extended appointment. Often, more anesthetic is given whenever the

patient feels discomfort, usually without first calculating the total dosage. Using multiple types of local anesthetics does not increase the maximum dose. The *ADA Guide to Dental Therapeutics* (Second Edition, ©2000, ADA Publishing) lists the maximum recommended doses approved by the U.S. Food and Drug Administration for available local anesthetics. It lists the recommended *maximum* adult dose for lidocaine with epinephrine at 7 mg/kg up to a total dose of 500 mg.[4] *A clinician would be prudent to leave a wide margin of safety and avoid approaching these published limits, as individual responses and tolerances to a particular anesthetic agent may vary greatly.* Various local anesthesia textbooks also contain dosing recommendations and advocate dosage maximums well below the FDA limit.

Vasoconstrictors. Most anesthetics have a vasoconstrictor added to prolong the duration of the anesthetic action. It acts by reducing blood flow and systemic absorption of the anesthetic. Peak plasma concentrations of an anesthetic agent are reached in 5-10 minutes without a vasoconstrictor and 20-30 minutes with one. Signs of vasoconstrictor overdose include cardiovascular effects such as elevation in blood pressure, elevated heart rate, and possible cardiac dysrhythmias. Patients may have symptoms such as anxiety, nervousness, restlessness, throbbing headache, tremors, perspiration, weakness, dizziness, pallor, or respiratory difficulty. The reaction to vasoconstrictors is usually so brief that no special management is necessary. However, if symptoms persist, remove any vasoconstrictor-laden retraction cord that may be in place and position the patient in an upright position. This posture minimizes cerebral blood pressure. Do your best to comfort the patient and, unless the patient is hyperventilating, administer oxygen. Wait until the patient feels and functions normally before letting him or her leave.[5]

Vasoconstrictors can pose a significant risk to certain individuals. They should be avoided or kept to a minimum for the following patients[3]:

- Blood pressure in excess of 200 mm Hg systolic or 115 mm Hg diastolic
- Uncontrolled hyperthyroidism
- Myocardial infarction less than 6 months ago
- Stroke less than 6 months ago
- Daily episodes of angina pectoris
- Coronary artery bypass surgery less than 6 months ago
- Patients taking tricyclic antidepressants. Tricylic antidepressants can potentiate the effect of vasoconstrictors. Examples include Tofranil (imipramine), Elavil (amitriptyline), and Sinequan (doxepin). (Newer, non-tricyclic antidepressants, such as Prozac (fluoxetine) and Paxil (paroxetine), are classified as selective serotonin reuptake inhibitors.)
- Patients taking nonspecific beta blockers. Beta blockers can enhance the response to epinephrine by increasing blood pressure and slowing the heart rate. Examples include Inderal (propranolol), Corgard (nadolol) and of lesser significance, Tenormin (atenolol) and Lopressor (metoprolol).
- Patients using cocaine. Cocaine can also potentiate the effect of vasoconstrictors. No dental injections should be given within 24 hours after cocaine use due to an exaggerated response which can include dysrhythmia, myocardial infarction or stroke.

Malamed recommends a maximum dose 0.04 mg of epinephrine for cardiac patients. This equates to approximately 2 cartridges of an anesthetic containing a 1:100,000 concentration of epinephrine.[3] If multiple quadrants are being treated, the timing of injections should be spread out. Alternatively, using a local anesthetic without a vasoconstrictor may be prudent.

While there are true risks involved in using epinephrine on cardiac patients, Malamed also points out that "the cardiovascularly impaired patient is more at risk from endogenously released catecholamines than from exogenous epinephrine administered in a proper manner." [3] Efforts made to make the patient comfortable and stress free are often more important than the relatively small amount of epinephrine given with a local anesthetic.

Allergy. Another potential adverse systemic response to local anesthetic agents is an allergic reaction. The good news is that true allergies to local anesthetics are very rare. The manifestations of allergic reactions can range from dermatitis to bronchospasm to anaphylactic shock. Most patient reports of "allergy" to local anesthetic agents are actually non-allergic responses to the local anesthetic, the vasoconstrictor, or the stress of the injection. Of the true allergic responses, more are in response to the metabisulfite, added to prevent oxidation of the vasopressor, than to the anesthetic agent itself. (The preservative methylparaben has not been used in local anesthetic dental cartridges since 1984.) Many patients reactive to metabisulfites also have a history of asthma. Any patient with a self-reported history of allergy to local anesthetic agents should be thoroughly queried and, when necessary, referred to a qualified allergist for further testing and evaluation.

Adverse Localized Events & Responses

Not all adverse responses and events associated with local anesthesia are systemic. We have received a variety of claims alleging the dentist caused a localized injury.

Needle breakage. The weakest part of the needle is where it attaches to the hub; this is where most needle breaks occur. When injecting, never bury the entire length of the needle into soft tissue, as doing so places greater stress on the needle/hub joint. Should the needle break when completely buried, it will often disappear entirely into the soft tissue and make retrieval significantly more difficult. If you are unable to retrieve a broken segment of needle, refer the patient to an oral surgeon or appropriate physician specialist. We received 37 claims from 1995 through 2002 that alleged a needle broke during a dental injection.

Paresthesia/anesthesia. Prolonged paresthesia of the tongue, lip, and oral tissues is a known risk of mandibular extractions and surgical procedures. However, it may also occur after nonsurgical dentistry, where a local anesthesia injection is the only plausible cause of the injury. [6] These claims are more frequent than broken needle claims, yet infrequently result in a payment to the patient. Most cases of paresthesia resolve within eight weeks, but there also have been cases of permanent paresthesia associated with a local anesthesia injection. If paresthesia persists three months after the injection, refer the patient to a neurologist or an oral surgeon knowledgeable in treating paresthesia.

The comparative safety of specific anesthetic agents and their incidence of producing untoward outcomes is a topic that warrants further investigation. Haas has reported that articaine (introduced in the U.S. in 2000 after widespread use in Europe and Canada) and prilocaine have a statistically significant higher incidence of lingual paresthesia, but had only speculative reasons for his findings. [1,7] However, Malamed, et. al. found that articaine produced "no serious adverse events related to the study medication" and that minor adverse events occurred with the same frequency as with lidocaine. [8]

Soft tissue injury. Communication is the key to preventing self-inflicted soft tissue injuries following the administration of local anesthesia. It is imperative that patients and parents of children be informed about the risks of testing for numbness by biting the tissue, in addition to advising them not to eat until the numbness abates.

Additional Recommendations

There are numerous aspects to managing the risks of local anesthetic injections, many of which have been indicated. The following are additional suggestions to better manage those risks.

Clinical

- Obtain a comprehensive medical history, including prior responses to various local anesthetic agents and current medication/drug use.
- Take baseline blood pressures at new patient and recall examinations.
- Know your patient's approximate weight and calculate safe anesthetic dosages, especially with children. Consider keeping a scale in the office.
- Know your anatomic landmarks and use proper techniques. Always aspirate and inject very slowly.
- *Use the least amount necessary to achieve anesthesia, always staying below the recommended maximum.*
- Stay in the room (or have an assistant do so) after the injection to monitor the patient's response.
- In case of an allergic reaction, have antihistamines (such as Benadryl®) and epinephrine (Epi-Pen) available.

Communication

- For mandibular blocks, advise patients that they may feel a transient stinging, burning, or shock type of sensation.
- Advise patients that they may feel different after the injection. (Often due to the general CNS depressive nature of local anesthetic agents.)
- Diligently follow up with patients who have had adverse responses.

Documentation

- Always document the local anesthetic agent given, its concentration, the volume given, the presence or absence of a vasoconstrictor, and the concentration of the vasoconstrictor.
- Document any adverse patient responses and your corrective action taken.

Summary

Local anesthesia is an essential and routine part of dental practice. Although the frequency of adverse events is low, the potential for severe injury exists. It is essential that clinicians minimize the risk to patients and be able to recognize and manage an adverse response.

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2. Moore, Paul A. "Adverse Drug Interactions in Dental Practice: Interactions Associated with Local Anesthetics, Sedatives and Anxiolytics." *Journal of the American Dental Association*, Volume 130, April 1999; pp. 541-554.
3. Malamed, Stanley. *Handbook of Local Anesthesia,* 4th Edition. Mosby, 1997.
4. *ADA Guide to Dental Therapeutics.* Second Edition. ADA Publishing, 2000.

5. Koerner, Karl R.; Taylor, Samuel E. "Emergencies Associated with Local Anesthetics." *Dentistry Today*. October 2002.

6. Pogrel, M. Anthony and Thamby, Sri. "Permanent Nerve Involvement Resulting From Inferior Alveolar Nerve Blocks." *Journal of the American Dental Association*, Volume 131, July 2000; pp. 901-905.

7. Haas, D.A.; Lennon, D. "A 21 Year Retrospective Study of Reports of Paresthesia Following Local Anesthetic Administration." *Journal of the Canadian Dental Association.* April 1995; 61 (4): pp. 319-320, 323-6, 329-30.

8. Malamed, Stanley F.; Gagnon, Suzanne; Leblanc, Dominique. "Efficacy of Articaine: A New Amide Local Anesthetic." *Journal of the American Dental Association*, Volume 131, May 2000; pp. 635-642.