

The Use of Anxiolytic Medications to Supplement Local Anesthesia in the Anxious Patient

Abstract: *Local anesthetic failures in dental patients can have many causes, including anatomical variations, technique, and anxiety/fear. By understanding the mechanisms responsible for failed local anesthesia, patients can be treated more comfortably. The interaction of anxiety and fear is discussed. Oral sedation dentistry is highlighted as a way to reduce anxiety/fear and the patient's perception of pain. Profound anesthesia can be accomplished more easily in relaxed patients with diminished or eliminated anxiety/fear.*

Perhaps no single factor has advanced the profession of dentistry as much as the introduction of effective local anesthesia. Since the original local anesthetic, cocaine, was first used to achieve dental anesthesia in 1884,^{1,2} the techniques of administration, knowledge of neural anatomy,³ development of safer more potent anesthetics, and an improved armamentarium have made local anesthesia an extremely reliable adjunct to the practice of dentistry. Effective local anesthesia has increased access to care for millions of patients and the dental profession has flourished as a result.

Despite these advances in pain control, there remain instances when achieving profound local anesthesia is a challenge. This is very distressing to the patient and is a source of extreme frustration for the practitioner. Malamed reported that density of the mandible, limited accessibility of the nerves, and anatomical variation can result in failure to achieve successful local anesthesia in up to 20% of inferior-alveolar block (IANB) injections.⁴ Others have noted that poor operator technique could be a cause of anesthetic failure.^{5,6}

Apart from anatomy and technique, the anxiety and/or fear level of the patient also can be an important cause of reduced local anesthesia efficacy. Milgrom states that, "Factors such as fear are clearly capable of influencing patient response to painful or other stimuli applied after administration of a local anesthetic. The relationship between these variables may be reciprocal: fear can lead to inadequate anesthesia and being treated with inadequate anesthesia can increase fear."⁷

This article explores the potential benefit of anxiety and fear reduction on the success of local anesthesia. The psychological aspect of local anesthetic failure is addressed with particular emphasis on patient sedation.

Anxiety and Fear

It is indisputable that anxiety and fear influence the success of dental treatment. Anxiety and fear are complex emotions that are commonly asso-

CE 2

Anthony S Feck, DMD

Private Practice
Lexington, Kentucky
Vice President
Dental Organization for Conscious Sedation
Philadelphia, Pennsylvania

Jason H Goodchild, DMD

Division Director of Oral Diagnosis
Department of Diagnostic Sciences
New Jersey Dental School
Newark, New Jersey
Clinical Assistant Professor
Department of Oral Medicine
University of Pennsylvania School of
Dental Medicine
Philadelphia, Pennsylvania

Learning Objectives:

After reading this article, the reader should be able to:

- discuss the relationship between fear/anxiety and local anesthetic failure.
- appreciate the pharmacological differences between lidocaine and articaine.
- describe the pharmacodynamic mechanism of benzodiazepine agents in relieving anxiety.

Table 1—Properties of articaine and lidocaine.²¹⁻²⁴

	T_{max} (seconds)	T_{1/2} elim (minutes)	Site of metabolism	Pregnancy category	Duration of action (minutes)
Articaine* (Septocaine, Ultracaine)			90% Rapidly hydrolyzed by blood and tissue esterases; Cytochrome P450 isoenzyme system is responsible for metabolism of approximately 5% to 10%		
A 4% solution with epinephrine 1:100,000 or 1:200,000	60-360	20-90		C	60-220
Lidocaine (Xylocaine, various)			Approximately 90% of a dose is metabolized via de-ethylation in the liver (CYP1A2 is the primary enzyme responsible for the metabolism)		
A 2% solution without with epinephrine 1:50,000 or 1:100,000	60-360	20-90		C	60-190

*Articaine has been relatively ineffective for dental anesthesia when given without epinephrine: Cowan A. Clinical assessment of a new local anesthetic agent-articaine. Oral Surg Oral Med Oral Pathol. 1977; 43(2):174-180.

ciated, though they do have marked differences. Anxiety is defined as apprehension to an unidentifiable stimulus, compared with fear where the stimulus is known.⁸ Because the provision of dental treatment involves both apprehension toward known and unknown causes, anxiety and fear will be considered together.

Apprehension of pain is one factor responsible for the avoidance of dental treatment. Pain is subjective but unpleasant and involves previous experiences, distractions, current emotional states, and cognitions.^{9,10} Tissue damage is not an accurate predictor of pain; rather, the patient's perception is the determinate.

It is believed that apprehension and increased pain perception are related.⁹ Pawlicki states, "There is a direct relationship between anxiety and acute pain. Increases in anxiety increase sensitivity to pain. Conversely, reductions in anxiety reduce the perception of pain."¹⁰

Administration of local anesthetic is a source of apprehension for dental patients. Consider patients who have received local anesthetic and are displaying signs of its effectiveness (ie, numb lip, cheek, and buccal mucosa after IANB) but continue to complain of procedural pain. For dental patients who report pain after receiving local anesthetic, psychological factors should be considered by the practitioner as a potential cause of failure.^{5,6,11,12} It is interesting to note that apprehension is a process occurring in the central nervous system, whereas local

anesthetic effectiveness is mediated by conduction of sodium ions at the peripheral site of action.

The physiological component responsible for enhanced pain perception after a seemingly effective local anesthetic injection certainly involves sympathetic nervous system activation. The "fight or flight" response causes increased alertness, heart rate, blood pressure, and respiratory rate—common signs of a typical apprehensive patient. Until an apprehensive patient can be relaxed, increased sympathetic tone will exaggerate the patient's pain response. Local anesthesia will be less successful in these patients.

Apprehension is learned but pain is perception. For patients who would otherwise experience no stimulus after an effective anesthetic injection, even the slightest perception is painful. A feeling of pressure or touch can create an expectation of pain, eliciting a response from the patient.⁹ The learned response (ie, apprehension) from past experience dictates the patient's reaction, often manifesting as pain when no discernable stimulus is possible, and when local anesthesia should be effective.

The learned versus perception phenomenon also may affect the dentist's choice of local anesthetic. In this case, the learned response comes from a previous failed attempt with one anesthetic, and when another local agent is administered and successful anesthesia obtained, the dentist perceives that the result was due to the second anesthetic.

Table 2—Properties of common benzodiazepines used for oral conscious sedation (Brand name in parentheses).²⁵⁻²⁷

	T _{max} (hr)*	T _{1/2 elim} (hr)**	Site of metabolism	Pharmacologic antagonist	Usual oral dose	Duration of action (hr)
Trazolam (Halcion)	1.25	2.5	CYP 3A4, 5-7	Flumazenil	0.125-0.5 mg	2-4
Midazolam (Versed)	0.5-1	1.2	CYP 3A3-5	Flumazenil	0.5 mg/kg	1-2
Lorazepam (Ativan)	1.2	15.7 (14-16)	Hepatic glucuronidation	Flumazenil	1-3 mg	6-8
Alprazolam (Xanax)	1.45	14.5 (12-15)	CYP 3A4	Flumazenil	1 mg	6-8
Diazepam (Valium)	1.12	33 (20-100)	CYP 1A2, 2C8, 2C19, 3A3-4	Flumazenil	5-10 mg	6-8

*T_{max} = Time to maximum plasma concentration, **T_{1/2 elim} = elimination half-life

The Dentist's Perception of Articaine versus Lidocaine

Since the local anesthetic articaine became available to US dentists in April of 2000, it has carried the reputation of improved efficacy compared with other amide local anesthetics.^{13,14} Dentists claim that articaine has better bone perfusion and that IANB injections are more effective if articaine is used. Despite anecdotal claims, the literature is replete with evidence that onset, duration, and anesthetic profundity of articaine are comparable to lidocaine.^{15,16} Malamed¹⁷ states, "we observed no significant difference in pain relief between subjects in the 4% articaine with epinephrine 1:100,000 group and those in the 2% lidocaine with epinephrine 1:100,000 group."

Structurally, articaine differs significantly from other amide local anesthetics. It contains a thiophene ring rather than a benzene ring, and has an additional ester linkage. The structural differences of articaine result in 2 clinical advantages. Articaine's thiophene ring improves diffusion through soft tissue and bone,¹⁸ and its additional ester linkage makes it subject to hydrolysis in the blood.¹⁷ Table 1 compares the pharmacokinetics of lidocaine and articaine.

Dental patients' assessments of local anesthetic success are subjective. So too is the choice of dentists to use one local anesthetic over another. A patient may describe negative past experiences, prompting the dentist to consider alternate strategies to achieve profound anesthesia. Regardless of conclusions in the literature, dentists may choose to administer articaine to patients deemed hard to anes-

thetize. It is the dentist's perception that articaine is more effective in this case.

Benefits of Sedation

As stated previously, reductions in anxiety will reduce the perception of pain. Sedation is a method the dental practitioner can use to reduce apprehension of dental treatment. Sedation is indicated for patients who may have difficulty achieving profound anesthesia because of apprehension.^{6,12,19} Most often recommended are the benzodiazepines because they quickly alleviate anxiety and have a wide therapeutic margin of safety. Table 2 contains a list of commonly used oral benzodiazepines for anxiolysis.

In addition to their role as adjuncts for the reduction of perioperative anxiety in dental patients, benzodiazepines also can increase the toxic threshold of local anesthetics.^{6,12} Benzodiazepines are not effective analgesics or anesthetics. They act by stimulating gamma amino-butyric acid (GABA), a major inhibitory neurotransmitter in the central nervous system. When benzodiazepines interact with GABA on cell membranes, chloride ions flow into the cell and cause depolarization. Depolarization raises the seizure threshold, normally an early sign of local anesthetic toxicity.

Case Study

A 34-year-old white woman presented for an endodontic consultation regarding treatment of 2 painful teeth. Her previous dentist attempted root canal therapy on these teeth but because of inadequate local anesthesia,

treatment was halted. A referral to have the teeth extracted under sedation was made because of the patient's past experiences with local anesthetic.

The patient recounted a history of painful dental treatment and inadequate numbness. When asked to clarify this, she responded that dental treatment has always been painful despite repeated injections of local anesthesia. Statements like, "I'm impossible to numb" or "I can't sit through that kind of pain" clearly indicated that the patient expected anesthetic failure and was anticipating a painful experience. As a result, the patient was very apprehensive about dental treatment.

The patient identified the focus of apprehension as local anesthesia ineffectiveness. If we could get her numb, she thought, then dentistry would be tolerable and her 2 teeth could be treated. Treatment options were discussed candidly with the patient and included referral to a specialist for dental care under intravenous deep sedation or general anesthesia. Other treatment alternatives were discussed including the use of orally administered anxiolytic medications for conscious sedation or nitrous oxide/oxygen. Both dentist and patient agreed upon oral conscious sedation with a benzodiazepine.

The patient underwent a comprehensive sedation workup. This included a collection of baseline vital statistics, a review of her medical history, pre- and postoperative instructions, and informed consent. A responsible adult was identified for transportation to and from the office on the day of sedation, and preoperative anxiolytic medication was dispensed.

The patient's medical history included recent laparoscopic bariatric surgery with banding, intermittent nausea, and hypertension. The patient was taking spironolactone/hydrochlorothiazide, promethazine, and tramadol/acetaminophen, and reported a gastrointestinal intolerance to narcotics. Her preoperative vital signs, including oxygen saturation numbers, were within normal limits. A consultation with her physician and a crosscheck of her existing medications, medical conditions, and planned operative medications did not raise any contraindications to oral conscious sedation.

The technique chosen for oral conscious sedation followed one of the protocols taught by the Dental Organization for Conscious Sedation.²⁰ The patient was given 5 mg of

diazepam to take orally the night before her appointment. The patient had nothing by mouth 6 hours before the appointment except for a small amount of water. The patient took 0.25 mg of triazolam 1 hour before the appointment and was driven to the office by her identified companion.

Physiologic monitoring with pulse oximetry began upon arrival, and the patient was assessed for signs of sedation. Based on a verbal and visual assessment, no discernable anxiolytic effect was noted. Another 0.25 mg of triazolam was administered sublingually. The patient was instructed to place the tablet under her tongue and let it dissolve.

The patient remained seated in the operatory under visual observation and pulse oximetry. Thirty minutes later, the patient began to demonstrate signs of light sedation. Visually she began to slump in the chair and her eyes began to droop. Verbally, she admitted feeling "buzzed" and "very relaxed." Although the patient appeared only slightly sedated, apprehension was notably diminished. A 30% nitrous oxide and 70% oxygen mixture was administered via nasal hood during the delivery of local anesthesia, and then discontinued for the remainder of the treatment. The following amounts of local anesthetic were delivered by conventional methods: 36 mg of prilocaine and 108 mg of lidocaine with 0.054 mg of epinephrine. As described, a total cumulative dose of 0.5 mg of triazolam was administered during the appointment (0.25 mg 1 hour before the appointment and 0.25 mg after the preoperative assessment).

The patient was comfortable throughout the procedure with normal vital signs and oxygen saturation levels. The dental treatment was uneventful with complete local anesthetic success. Possibly because of the amnesic effect of the sedative medications, when contacted the following day, the patient had little to no memory of the dental treatment. More importantly, she reported no postoperative discomfort.

Discussion

Most practitioners have experienced patients similar to the one described in this case. The common nature of the case does not make it outstanding, rather it describes a technique of overcoming apprehension as an obstacle to effective local anesthesia.

Sedation is a treatment adjunct that all dentists can use. State dental laws outline the educational requirements and equipment needed to perform in-office sedation. Many states require additional permits or certification to perform oral conscious sedation, and all dentists wishing to perform in-office sedation should comply with state laws before using any of the techniques described in this article.

Unpleasant painful experiences are a major factor in the avoidance of dental care. However, in this case, pain motivated the patient to seek an effective alternative treatment strategy. The patient recounted many previous attempts at dental therapy and was frustrated by the continued pain. Although the focus of her apprehension was ineffective local anesthesia, 2 other factors played a role. First, because of a low pain tolerance, the patient expected to feel pain during dental treatment and second, the patient had lost hope that a dentist could empathize with her situation.

The patient admitted that anesthesia was impossible and that she had a low pain tolerance. She expected to feel pain. Despite repeated injections of local anesthesia and signs of anesthesia, the patient continually complained of discomfort and pain. Because she never had a feeling of complete numbness during dental treatment, in her mind pain could never be eliminated, it had to be tolerated.

Not explained previously in the case report, but equally important was the issue of trust. The patient clearly distrusted dentists and equated failed anesthetic technique with operator incompetence. Every time she underwent dental treatment and suffered, a dentist told her that she “must be numb.” The patient commented that dentists did not “listen,” “respect,” or “care” about her issues with pain. This clearly indicated her skepticism toward dentists and their ability to empathize with her discomfort. Just as she expected to feel pain, she expected to be admonished by the dentist for complaining of pain when “no pain could be possible.”

Sedation is an extremely valuable tool to help patients. However, sedation would not have been effective unless this patient’s specific concerns were identified and addressed. Because apprehension of sudden, acute, uncontrolled pain is a primary concern for most patients, we counseled this patient on what to

expect during her treatment.^{9,19} We explained the effects of the anxiolytic medication and that local anesthesia will be more effective when she is relaxed. We also established trust by giving the patient control.¹⁰ It was understood that if the patient felt discomfort and wanted pain relief, it would be immediately given without question.

Sedation can be useful for another reason. Stress can have deleterious effects on the body. Some patients are less capable of tolerating stress during dental treatment and for these patients increases in sympathetic activity can precipitate a medical emergency. Reductions in both stress and apprehension, together with profound local anesthesia, will create a safer and more successful environment for these patients.

Conclusion

Apprehension expressed toward a known or unknown stimulus must always be considered as a potential cause of anesthetic failure. By understanding that apprehension will alter the patient’s perception of events, we can better manage unpleasant stimuli. For some patients, the use of anxiolytic medications can break the cycle of apprehension and local anesthetic failure. A reduction in apprehension will cause a reduction in the perception of pain. A reduction in apprehension also will decrease sympathetic tone, which will result in fewer circulating catecholamines and a more relaxed patient.

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Quiz 2

1. Malamed reported that which of the following can result in failure to achieve successful local anesthesia in up to 20% of inferior-alveolar block injections?
 - a. density of the mandible
 - b. limited accessibility of the nerves
 - c. anatomical variation
 - d. all of the above
2. What is defined as apprehension to an unidentifiable stimulus?
 - a. fear
 - b. anxiety
 - c. pain
 - d. reflex
3. _____ is where the stimulus is known?
 - a. fear
 - b. anxiety
 - c. pain
 - d. reflex
4. Which of the following about apprehension and pain is correct?
 - a. Apprehension is perception and pain is learned.
 - b. Apprehension is learned and pain is perception.
 - c. Both apprehension and pain are learned.
 - d. Both apprehension and pain are perception.
5. Sedation is indicated for patients who may have difficulty achieving profound anesthesia because of:
 - a. diffuse inflammation.
 - b. localized inflammation.
 - c. apprehension.
 - d. local anesthetic intolerance.
6. Benzodiazepines are not effective analgesics or anesthetics because they act to stimulate:
 - a. gamma amino-butyric acid.
 - b. acetylsalicylic acid.
 - c. paraaminobenzoic acid.
 - d. methyl ethyl ketone.
7. The patient in this article identified the focus of apprehension as:
 - a. fear of endodontics.
 - b. local anesthetic effectiveness.
 - c. fear of extraction.
 - d. fear of needles.
8. In this case, physiologic monitoring with _____ was begun upon arrival?
 - a. blood pressure cuff
 - b. stethoscope
 - c. pulse oximetry
 - d. laser doppler flow meter
9. Dentists not listening, respecting, or caring were verbal cues that clearly indicated:
 - a. a poorly trained dental staff.
 - b. the patient's skepticism.
 - c. the patient's psychosis.
 - d. local anesthetic failure during previous treatments.
10. In this case, sedation would not have been effective unless:
 - a. long-acting local anesthetics were used.
 - b. premedicating with ibuprofen was done.
 - c. the patient received a post-operative phone call from the dentist.
 - d. this patient's specific concerns were identified and addressed.

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