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Drugs, diseases, and decisions: The interaction between injectable local anesthetics and systemic diseases

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Abstract

Local anesthetics designed for use in the dental setting are safe and effective medicaments, yet their utilization requires careful considerations in an effort to reduce the risk of adverse reactions for the dental patient. The medical history is an integral key to this consideration, as there is a potential for drug interactions or complications in compromised patients. The relative and absolute contraindications affiliated with the safe delivery of local anesthesia for the dental patient vary widely in relation to the systemic disease or condition. Understanding these contraindications and applying these clinical decision-making modalities when considering local anesthesia selection, dosage, and delivery are critical in the safe and efficient delivery of injectable and noninjectable drugs in the dental setting.

This course seeks to improve the dental care provider's understanding of the interaction between injectable local anesthesia and various systemic conditions as well as aid in the clinical decision-making needed for the provision of safe local anesthesia delivery for compromised patients in a dental setting.

Educational objectives

Upon completion of this course, the dental professional should be able to:

- Understand the current scientific literature about the potential complications between injectable local anesthesia and systemic disease.
- Review injectable local anesthesia considerations in the management of oral pain.
- Discuss chronic diseases requiring modifications in the delivery of injectable local anesthesia, including cardiovascular disease, diabetes, thyroid disease, respiratory disease, hepatic and renal dysfunction, central nervous system disorders, endocrine disease, and hematologic disorders.
- Discuss conditions that may require modifications to the delivery of injectable local anesthesia, including allergies, pregnancy, and recreational drug use.
- Identify specific clinical decision-making strategies in the provision of safe injectable local anesthesia delivery.

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The mission to improve the safety and quality of dental care has never been more essential. Dentistry has the opportunity to become proactive and therefore actively engaged in the protection of the community while enhancing the profession through high-level standards of excellence. Industry-standard periodicals continually encourage the dental community to improve safety in the provision of local anesthesia delivery as a means of improving generalized dental patient outcomes.

The average dentist delivers upward of 1,500 cartridges of local anesthetic per year,[1] and as such, a common complication noted in the dental chair results from the delivery of local anesthesia and sedation.[2] In addition, approximately 45% of Americans present with a chronic medical condition, and 21% of Americans present with multiple chronic medical conditions.[3]

As such, it is imperative for the dental clinician to understand the relative and absolute contraindications as well as the considerations required in the provision of pain management, particularly in the utilization of injectable local anesthetics. The following article unpacks the current research as it relates to patient safety within the provision of dental injectable local anesthetics.

Patient safety in local anesthetics

A comprehensive review of the patient is imperative for the safe and efficient utilization of local anesthetics. This review includes a medical history questionnaire to determine the patient's ability to tolerate the physical and psychological stresses of dental treatment as well as treatment modifications that may be indicated and whether there are any contraindications to any of the drugs to be used.

Utilizing the American Society of Anesthesiologists' (ASA) physical status classification system[4] **[**table 1**],** the clinician is able to better understand potential treatment modifications required to best suit the unique needs of patients with advanced conditions. While this status is primarily used for the sedation and/or intubation of patients, it provides a valuable tool with regard to the potential risks anesthetics may institute on vital organ systems.

TABLE 1. American Society of Anesthesiologists' physical status classification system

ASA Classification	Conditions
I–Healthy	Blood pressure status: <140 and <90. Under 60 years of age. No systemic diseases. Not phobic.
II–Mild systemic disease	Blood pressure status: 140-159 and/or 90-94. Over 60 years of age. Allergies. Pregnancy. Glaucoma. History of myocardial infarction >6 months prior with little or no residual damage. Upper respiratory tract infection. History of postural hypotension. Controlled epilepsy. Recent corticosteroid usage with limited disability. Mild heart failure without disability. Mild congenital heart lesion. Nonpathologic heart murmur. Mild rheumatic heart fever. History of cerebrovascular accident with recovery and uneventful disability. Well-controlled asthma. Arrested tuberculosis. Mild emphysema. Undetectable viral load: HIV+. Sickle cell anemia. Mild herpes. Mild renal dysfunction. Mild thyroid disease. Controlled non-insulin-dependent diabetic. Dental anxiety or phobia. Stable prosthetic heart valve. Stable pacemaker.
III–Severe systemic disease	Blood pressure status: 160-199 and/or 95-114. Stable angina. History of myocardial infarction >6 months prior with residual damage. Chronic bronchitis or chronic lung disease. History of transient ischemic attack. Uncontrolled postural hypotension. Uncontrolled epilepsy. Recent corticosteroid usage with significant disability noted. Significantly disabled arthritis. Heart failure in which disability develops from exertion or stress. Moderate congenital heart lesion. Heart murmur with regurgitation. Moderate rheumatic heart fever. Transient cerebral ischemia. History of cerebrovascular accident >6 months. Stress-induced asthma. Moderate emphysema. Mild detectable viral load: HIV+. Moderate sickle cell anemia. Moderate herpes. Moderate anephric patient. Moderate renal dysfunction. Moderate thyroid disease. Uncontrolled non-insulin-dependent diabetic. Controlled insulin-dependent diabetic. Patient receiving psychiatric care/drug therapy. Unstable prosthetic heart valve. Unstable pacemaker.
IV–Severe systemic disease that is a constant threat to life	Blood pressure status: 200+ and/or 115+. Unstable or recent onset angina. History of myocardial infarction <6 months prior. Severely uncontrolled epilepsy. Significant hepatic dysfunction. History of dyspnea for a heart failure patient at rest. Significant congenital heart lesion. Advanced heart murmur requiring premedication antibiotics. Severe rheumatic heart fever. History of cerebrovascular accident <6 months. Frequent hospitalizations from uncontrolled asthma. Severe emphysema. Moderate detectable viral load: HIV+. Hospitalized cancer patient. Severe herpes. Severe anephric patient. Severe thyroid disease. Uncontrolled insulin-dependent diabetic.
V–A moribund person who is not expected to survive 24 hours without an operation	Severe HIV+/AIDS. Severe hospitalized cancer patient. Extreme herpes. Terminally ill.
VI–A declared brain-dead person whose organs are being removed for donor purposes	

Common local anesthetic agents are bupivacaine, lidocaine, mepivacaine, prilocaine, and articaine.[5] These agents may present with varying concentrations of the drug and/or vasoconstrictors. As such, the clinician must become well versed in understanding the different concentrations of medicaments and their potential limitations in various patient situations **[**table 2**]**.

It is worth noting that while all current injectable dental local anesthetics are amides, some anesthetics present with unique considerations and potential contraindications for specific patient populations. As such, some anesthetics may carry

TABLE 2. Common injectable drugs in dentistry

Drug	Duration of action	Max doses in 70 kg person	Cardiac dosage	Pregnancy category
2% lidocaine 1:100,000 epinephrine	Pulpal: 60 min Soft tissue: 180-300 min	11 cartridges	2 cartridges	B
2% lidocaine 1:50,000 epinephrine	Pulpal: 60 min Soft tissue: 180-300 min	5.5 cartridges	1 cartridge	B
2% mepivacaine 1:20,000 levonordefrin	Pulpal: 60 min Soft tissue: 180-300 min	11 cartridges	4 cartridges	C
3% mepivacaine plain	Pulpal infiltration: 20 min Pulpal block: 40 min Soft tissue: 120-180 min	7.5 cartridges	ideal	C
4% prilocaine plain	Pulpal infiltration: 10-15 min Pulpal block: 40-60 min Soft tissue infiltration: 90-120 min Soft tissue block: 120+ min	8.3 cartridges	ideal	B
4% prilocaine 1:200,000 epinephrine	Pulpal infiltration: 60-90 min Soft tissue: 180-480 min	8.3 cartridges	4 cartridges	B
4% articaine 1:100,000 epinephrine	Pulpal: 60-75 min Soft tissue: 180-300 min	7 cartridges	2 cartridges	C
4% articaine 1:200,000 epinephrine	Pulpal: 45-60 min Soft tissue: 120-300 min	7 cartridges	4 cartridges	C
.5% bupivacaine 1:200,000 epinephrine	Pulpal: >90 min Soft tissue: 240-720 min	10 cartridges	4 cartridges	C

TABLE 3. Cartridge limitations for cardiovascularly impaired patients

1:50,000 dilution l epinephrine	1 cartridge
1:100,000 dilution l epinephrine	2 cartridges
1:200,000 dilution l epinephrine	4 cartridges
1:20,000 dilution l levonordefrin	4 cartridges

TABLE 4. Medical considerations for cardiac dosages of vasoconstrictor

Unstable angina
Recent myocardial infarction
Decompensated heart failure
Significant dysrhythmia
Severe valvular disease
Significant cardiovascular disease [ASA III or IV]
Recent cerebrovascular accident
Potential drug interactions: Tricyclic antidepressants, such as Elavil (amitriptyline) or Tofranil (imipramine) Phenothiazines, such as Haldol (haloperidol) Nonselective beta-blockers, such as Inderal (propranolol) Digitalis glycosides, such as Lanoxin (digoxin)

cautions or warnings with regard to relative or absolute contraindications. Also, those anesthetics containing a vasoconstrictor may carry additional warnings and subsequent caution with regard to the provision of safe local anesthetic delivery.

Vasoconstrictors

Within the cartridge itself, dental anesthetics may contain an additive vasoconstrictor. Vasoconstrictors are drugs used to 1) constrict blood vessels, thus decreasing blood flow to the site, 2) slow the absorption of anesthetic into the cardiovascular system, 3) lower blood levels of anesthetic, thus reducing risk of toxicity, 4) increase duration of action by encouraging greater amounts of local anesthetic to enter the nerve and remain for a longer period of time, and 5) decrease bleeding at the site, thus they are deemed useful in procedures in which bleeding is anticipated.

The ratio of vasoconstrictors used in the United States in local anesthetic cartridges ranges from 1:50,000 epinephrine to 1:200,000 epinephrine, and 1:20,000 levonordefrin respectively. In normal healthy patients, the maximum recommended dose of epinephrine is .2 mg per appointment, or 11 cartridges of 1:100,000 dilution. However, in patients with clinically significant cardiovascular impairment, the maximum recommended dose, otherwise termed the "cardiac dose," is .04 mg of epinephrine and subsequently, .2 mg of levonordefrin [table 3].

For patients determined to be medically capable of undergoing general dentistry, it is worth noting that there are no current recommendations regarding specific patients in which the use of the "cardiac dose" should be considered. Nevertheless, several cardiac patients who may be at particular risk for potential cardiovascular events following the delivery of local anesthetics with vasoconstrictor are listed in table 4.[6]

Due to potential risks associated with patients taking specific medications, some experts caution clinicians to avoid the delivery of epinephrine in all patients taking nonselective beta-blockers or digitalis glycosides.[7]

A statement about vasoconstrictors from the American Dental Association and American Heart Association advises that vasoconstrictor agents should be used only when the procedure itself will

be shortened by the utilization of the agent or in an instance in which the analgesia is rendered more profound. Should a vasoconstrictor be indicated, the clinician must proceed with extreme care to avoid risk of intravascular injection with the minimum possible amount of vasoconstrictor being used.[8]

While undesired effects following the injection of vasoconstrictors can occur, the adverse event itself is most often short-lived due to the quick reuptake and rapid biotransformation of vasoconstrictors. Finally, it is worth noting that patients with dental fear or anxiety will release quantities of endogenous epinephrine, and as such, this may also be a relevant factor to consider when determining safe doses of vasoconstrictors.

Cardiovascular disease

Local anesthetic drugs have a direct influence on the myocardium and the peripheral vasculature. As blood levels of anesthetics increase, myocardial depression occurs, decreasing the electrical excitability of the myocardium as well as the rate of conduction and force of contraction. In addition, with the exception of cocaine, local anesthetics produce vasodilation in which the smooth muscles in the walls of the blood vessels are relaxed, thus permitting increased blood flow to and from the site of drug deposition.[5]

As such, it is imperative for the prudent clinician to understand the potential cardiovascular risks associated with the delivery of local anesthetics. In addition, understanding additive products within the cartridge is imperative, particularly when discussing the use of vasoconstrictors.

Hypertension

The primary effect of local anesthetics on blood pressure is hypotension; however, local anesthetic injections with the presence of a vasopressor or vasoconstrictor have the potential to increase blood pressure. In patients with a history of hypertension, the clinician must evaluate 1) the controlled or uncontrolled state of blood pressure, and 2) the medication(s) the patient may be taking to control blood pressure, as well as potential drug interactions when integrating local anesthesia into dental care.[4] This will help the clinician identify potential treatment considerations as they relate to the provision of local anesthesia delivery [table 5].

TABLE 5. Blood pressure and treatment considerations

Blood pressure	ASA classification	Treatment consideration
<140 and <90	I	Routine dental treatment is acceptable. Recheck blood pressure in six months.
140-159 and/or 90-94	II	Recommended dental treatment may be initiated with a prompt referral to a physician.
160-199 and/or 95-114	III	Administer vasoconstrictor slowly, in minimal doses and after negative aspiration has been ensured. For blood pressure values ≥180/110, all elective treatment should be deferred with a referral to a physician.
200+ and/ or 115+	IV	Treatment should be deferred. The patient should be referred to a physician immediately.

Notably, the decision to provide elective dental treatment in the presence of significant hypertension must be based on a combination of factors including consultation with the patient's treating physician, physiological status, and psychological status.[9]

History of heart defects

A history of myocardial infarction (MI) may demonstrate concerns with regard to the delivery of traditional or elective dental care. Notably, the clinician must ask about the amount of time elapsed since the MI and the severity and degree of damage from the MI. Most patients who have suffered an MI within six months or fewer are considered ASA IV (presence of dyspnea at rest) and must receive medical clearance from the cardiologist prior to proceeding with dental treatment of any kind. Patients who have suffered an MI six months or longer ago are considered an ASA III (mild disability following heart failure) unless little or no residual damage was noted following the MI, in which case the patient would be considered an ASA II (no disability).[5,10]

Congestive heart failure (CHF) is defined as a weakness within the heart muscle to pump efficiently. Notably, those suffering with CHF may require supplemental oxygen during their dental procedures. Additionally, depending on the severity of the heart failure, the patient may be described as an ASA II, ASA III, or ASA IV.[5] While vasoconstrictors are encouraged due to their potential ability to provide a longer duration of pain control and a subsequent reduction in potential stress during the dental appointment, care should be taken to reduce the amounts of vasoconstrictors to reduce the potential threat of increased cardiac work.

Cardiovascular prosthetics

Patients with congenital heart lesions may represent ASA II, III, or IV, depending on the nature of the lesion and the degree of subsequent disability. With regard to the provision of local anesthetics, surgery-specific risks of cardiac challenges are related to the type of procedure itself and the degree of stress the procedure may elicit from the patient. As such, the clinician is encouraged to consider a medical consultation prior to proceeding with dental treatment to identify potential anesthetic accommodations as well as potential prophylactic antibiotic prescriptions, particularly in pediatric patients.[5]

Angina

Angina, defined in part as chest pain by exertion, classifies a controlled patient as ASA III and unstable or recent-onset patients as ASA IV. In these patients, nitrous oxide inhalation sedation is preferred to reduce dental stress, and effective pain control, including local anesthesia with vasoconstrictor, is indicated.

Thrombosis

Patients with a thromboembolic disorder should be assessed for the potential

to develop excessive bleeding, especially if the injection technique to be employed involves an increased risk of blood vessel penetration. These would include the posterior superior alveolar (PSA) block, the inferior alveolar (IA) block, and the infraorbital (IO) block, which should be avoided in favor of supraperiosteal and periodontal ligament injections that do not pose the threat of excessive bleeding.[11]

Diabetes

Proper treatment planning and assessment is essential for patients with type 1 or type 2 diabetes. While it is generally understood that morning appointments are preferred due to scheduling meals and doses of insulin and/or oral hypoglycemic medications, the goal is to assess and ascertain that the patient's blood glucose is well controlled before the administration of local anesthesia. This is especially true for patients who have a history of poor blood sugar control as evidenced by frequent hypo- and hyperglycemic episodes since epinephrine administration in these individuals may result in dangerous elevations in blood sugar.[12]

Respiratory disease

The action of local anesthetics may produce two effects. In safe dosage levels, local anesthetics have a direct impact on relaxing the smooth muscle of the bronchi. In overdose levels, local anesthetics have the potential to produce respiratory arrest due to generalized depression of the central nervous system.[5]

Additionally, the release of endogenous vasoconstrictors in the presence of stress oftentimes triggered by injectable local anesthetics may provoke a physiological and psychological reaction that may induce stress on the respiratory system, leading to a potential emergency situation.[13] Most notably, asthma may be induced in the presence of allergy, which may be exacerbated by the integration of sodium metabisulfites found in local anesthetic agents containing vasoconstrictors.

Sodium metabisulfite sensitivity

Sodium metabisulfites are added as an antioxidant to the cartridge of local anesthetics containing vasoconstrictors. It should be noted that sodium metabisulfite will also render the anesthetic solution more acidic, containing a greater proportion of charged cation molecules in relation to those uncharged neutral base molecules. As such, the delivery of anesthetic solution with sodium metabisulfite may deliver a transient burning sensation upon delivery.[5,11,12]

On rare occasions, patients may present with a sodium metabisulfite sensitivity in which the delivery of local anesthetics with sodium metabisulfite loaded in the cartridge (namely those with vasoconstrictors) would be contraindicated.[12] While patients may not report a sodium metabisulfite sensitivity on their medical history form, they may report a sensitivity to food products containing sulfites, such as wine and beer, or foods with preservatives like those found in salad bars, many condiments, and shellfish, to name a few.[14]

Hepatic and renal dysfunction

Significant dysfunction of the liver or kidney systems describes an ASA III patient, which may indicate local anesthetics as a relative contraindication. It should be noted that most amide local anesthetics undergo primary biotransformation (metabolism) in the liver. As such, the presence of severe liver dysfunction may present as either a relative or absolute contraindication in which the clinician may consider the use of amide drugs.[5,11,12]

However, articaine HCl undergoes biotransformation within the liver enzymes and additionally and largely within the plasma cholinesterase. As such, articaine HCl is considered the preferred injectable agent as it reduces half-life of metabolism in comparison to other amide drugs.[15]

Central nervous system disorders

As a general notation, local anesthetics are central nervous system (CNS) depressants. In patient conditions in which the CNS is depressed, the addition of a local anesthetic agent can further depress the condition. This can be observed, for example, in patients who take narcotic drugs before the delivery of local anesthetics; the addition of a local anesthetic to a CNS flooded with narcotics will provide a profound depression of the CNS.[5,12]

Patients who have suffered a cerebrovascular accident (CVA) or stroke hold an increased risk for future CVA or seizures. As such, the clinician must ensure they achieve effective pain control to reduce the risk of instilling stress during the dental procedure. Delivery of injectable anesthetic with vasoconstrictors is encouraged, although epinephrine concentrations should be limited due to the sensitivity of the central nervous system.

Epilepsy

Controlled epileptics are ASA II risks while those with greater frequency of seizures may represent ASA III or IV risks. Sedation is preferred for a particularly fearful epileptic patient, and it should be noted that tonic-clonic (grand mal) seizure activity manifests from overdose of local anesthetics.

In rare cases, patients may demonstrate cardiac arrhythmias and epileptic seizures in reaction to local anesthetics, particularly lidocaine. Experts advise that in all cases in which local anesthetic is planned, necessary precautions should be taken to manage potential but rare complications.[16]

Psychoses

Anxiety and fear can produce both psychological and physiological challenges within the body, which may affect the ability to administer and subsequently observe the effectiveness of local anesthesia. Most notably, dental anxiety classifies a patient as an ASA II.[12] Trypanophobia is the phobia of needles. Prior identification of a needle phobia may prevent subsequent syncopal episodes or other potentially adverse reactions to the delivery of local anesthetics.

Finally, patients taking medications to manage their psychoses may present with a relative contraindication for the delivery of injectable local anesthetics. Of note, lidocaine (43.17%) and bupivacaine (16.32%) are the most common local anesthetics responsible for adverse drug reactions associated with local anesthetics.[17] The clinician must understand potential adverse drug interactions between prescribed or self-prescribed medications

and/or supplements and local anesthetic agents [table 6].

Endocrine disease

Dysfunction of the thyroid is the second most common disorder within the endocrine system.[18] Endocrine disease may include manifestations such as hypothyroidism (decrease in thyroid gland function and hormone release); Hashimoto's disease, which contributes to hypothyroidism; hyperthyroidism (a lack of regulation of hormone production); Grave's disease, which contributes to hyperthyroidism; and challenges associated with adrenal insufficiency as seen in Addison's disease.[11,12]

Thyroid disease

Patients with controlled hyperthyroidism have an increased risk of developing thyroid storm, which may be exacerbated by the administration of local anesthetics with epinephrine. While the relationship between hyperthyroidism and epinephrine is not entirely clear, significant reactions may be prevented or minimized by either avoiding the use of epinephrine or by using minimum effective concentrations. The use of local anesthetic agents with epinephrine is contraindicated in patients with poorly controlled or uncontrolled hyperthyroidism.[12]

Adrenal insufficiency

Patients with primary adrenal insufficiency (Addison's disease) lack endogenous cortisol and aldosterone and require daily steroid therapy to replace them. These patients are unable to physiologically adapt to stress and may need supplemental steroid therapy when having dental procedures to prevent adrenal crisis. The need for sufficient and adequate volumes of local anesthetic agent and proper technique to ensure profound anesthesia and prevent pain-induced stress is critical in managing these patients.

Hematologic disorders

Hematologic or bleeding disorders may include disorders such as hemophilia and von Willebrand's disease, as well as acquired deficiencies such as vitamin K deficiency, thrombocytopenias, and vascular disorders such as scurvy, Cushing syndrome, and Ehlers-Danlos syndrome, to name a few. Bleeding disorders can also include self-reporting of chronic nasal or oral bleeding as well as significant or prolonged bleeding following dental treatment. Prolonged bleeding may also occur in a patient taking anticoagulant drugs, including drugs of abuse such as alcohol or heroin, which may cause excess bleeding and lead to liver damage.[19]

Bleeding disorders associated with prolonged bleeding time and/or frequent bruising may require modifications to the provision of dental therapy. The concerns of blood vessel injury and subsequent development of hematoma or ecchymosis within the soft tissue are frequent in sites in which risk of positive aspiration is high. As such, caution is encouraged upon needle penetration into the sites in which high vascularity is expected, such as delivery of a posterior superior alveolar nerve block in which approximation into the pterygoid plexus of veins and/or the maxillary artery is expected, or to the inferior alveolar nerve block. Additional locations in which risk of a positive aspiration is high include the mental nerve block and the incisive nerve block.[5,11,12] In addition, the Gow-Gates and Vazirani-Akinosi nerve blocks require injections deep into the tissues and may be difficult to manage in hematologic disorders.[5]

Methemoglobinemia

Defined as an acquired or genetic condition in which there is a reduction of the oxygen-carrying capacity of the hemoglobin, methemoglobinemia provides a contraindication for the administration of topical benzocaines as well as injectable prilocaine. As such, experts warn that benzocaine and prilocaine should be administered with caution.[5,11,12]

In some cases, methemoglobinemia is drug-induced. In addition to the delivery of topical benzocaine or injectable prilocaine, medications such as acetaminophen, acetanilide, aniline dyes, chloroquine, dapsone, sulfonamides, naphthalene, nitrates, nitrites, nitrofurantoin, nitroglycerin, nitroprusside, pamaquine, para-aminosalicylic acid, phenacetin, phenobarbital, phenytoin, primaquine, and quinine can induce a methemoglobinemia episode.[20] Notably, clinicians are advised to avoid the use of benzocaine or prilocaine in patients using any of the above noted medications to reduce the concerns of a drug-induced methemoglobinemia.[12]

Sickle cell anemia

Sickle cell disease is exclusively seen in Black patients in which periods of stress or hypoxia may precipitate the disease. As such, concerns of congenital or idiopathic methemoglobinemia may require a relative contraindication to prilocaine. In addition, patients who are experiencing a crisis associated with sickle cell disease should not receive local anesthesia or any dental treatment. It should also be noted that the use of vasoconstrictors should be limited while experts encourage shortened procedure times with plain anesthetic as a preferred means of managing a sickle cell patient.[5,12]

Atypical plasma cholinesterase

Patients with atypical plasma cholinesterase have an impairment in metabolizing ester-type anesthetics. While relatively rare and recessive, caution should be used

TABLE 6. Modifications to local anesthesia delivery for common medications

Medication	Modifications
Antipsychotics	Avoid the delivery of higher doses of anesthetic drugs.
Antidepressants	[Tricyclic] Limit doses of epinephrine. Avoid levonordefrin [SSRI, central alpha-2 agonist, dopamine reuptake inhibitor]. Use caution.
Anxiolytics	Limit dosages.
Monoamine oxidase inhibitors	None
Phenothiazines	Limit doses of epinephrine. Do not use 1:50,000 epinephrine.

when administering local anesthetics for these patients, as the risk of an ester local anesthetic overdose is much higher.

Clinicians are advised that ester anesthetics can be delivered with caution as a relative contraindication; however, it is acknowledged that there are excellent amides available for both topical and injectable delivery. As such, experts notate that esters should only be considered for use in the presence of both atypical plasma cholinesterase and a subsequent amide allergy, rendering the use of esters as a rare necessity.[5,12]

Pregnancy

Pregnant patients are considered an ASA II, and pregnancy serves as a relative, albeit temporary, contraindication to the delivery of local anesthetics. While the second trimester is typically considered to be the safest period for dental procedures, dental professionals are encouraged to seek medical clearance from the treating obstetrician prior to initiating treatment.

Lidocaine and prilocaine are classified as FDA pregnancy category class B drugs, while articaine, bupivacaine, and mepivacaine are classified as class C drugs. Lidocaine enters the breast milk in small amounts, while the safety of articaine, mepivacaine, prilocaine, and bupivacaine during lactation has not been established. Caution should be exercised by the patient when nursing after anesthetic administration.[5,11,12]

Malignant hyperthermia

Malignant hyperthermia is a pharmacogenetic disorder in which an individual experiences unique variants in response to certain drugs. This response may include manifestations such as tachycardia, tachypnea, erratic blood pressure, cyanosis, respiratory and metabolic acidosis, fever, rigidity of the musculature, and death. Of note, mortality rates of malignant hyperthermia range from 63% to 73%.[21]

Previous literature entities advised against the use of amide local anesthetics, stating that they were absolutely contraindicated in an individual with malignant hyperthermia, believing that amides had the ability to provoke clinical manifestations of malignant hyperthermia. This information has been evaluated by the Malignant Hyperthermia Association of the United States, and at this time, medical and dental literature does not provide ample documentation to support the trigger of malignant hyperthermia by amide drugs.[22]

Recreational drug use

In general, drugs that produce a depression of the central nervous system, such as opioids, antianxiety drugs, phenothiazines, and barbiturates, to name a few, have the potential to further depress the central nervous system when local anesthetics are administered. Additionally, one must consider the metabolic pathway of local anesthetics, acknowledging the biotransformation of anesthetics both in the liver and within the plasma pseudocholinesterase. As such, other prescription or recreational drugs that share the same metabolic pathway may produce adverse reactions.[12]

Local anesthetics are absolute contraindications for several recreational drugs, particularly if drug use has occurred within 24 hours of potential anesthetic delivery. Notably, the risks associated with specific dosages of anesthetic and/or use of vasoconstrictors can potentially elicit a medical emergency situation[23] [table 7]. Key experts advise that if drug abuse is suspected, patients are to be asked about recent consumption of substances, and if needed, may also be required to sign a statement indicating that drugs have not been used within 24 hours of the dental procedure.[5,11,12]

TABLE 7. Local anesthetic modifications with recreational drug use

Drug	Modification
Methamphetamine	Avoid vasoconstrictor use for 24 hours after methamphetamine use.
Cocaine	Avoid vasoconstrictor use for 24 hours after cocaine use.
Alcohol	Use caution and reduce dosages to avoid overdose.

Summary

The comprehensive assessment and continual evaluation of the dental patient's ability to safely and efficiently receive dental anesthesia is a foundation for the provision of safe local anesthetic delivery. As such, clinicians must continually perform routine evaluations, consider medical consultations when needed, and actively institute modifications to standard pain control techniques if needed. Finally, patients should always be monitored prior to, during, and concluding the administration of local anesthetic to permit opportunities for active observation of reactions to injectable anesthetics and potentially for the timely and efficient management of a medical emergency.

By understanding current guidelines around appropriate assessments and treatment considerations in the provision of local anesthetic delivery, clinicians can integrate a safe approach to treating and subsequently managing dental patients receiving local anesthetic.

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Notes

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QUESTIONS

1. The average dentist delivers upward of 1,500 cartridges of local anesthetic per year. Approximately 45% of Americans present with a chronic medical condition.
   A. The first statement is true and the second statement is false.
   B. The first statement is false and the second statement is true.
   C. Both statements are true.
   D. Both statements are false.

2. A blood pressure of 140-159 (systolic) and 90-94 (diastolic) corresponds to which of the following ASA classifications?
   A. ASA I
   B. ASA II
   C. ASA III
   D. ASA IV

3. Which of the following anesthetic agents is available with 1:50,000 epinephrine?
   A. Mepivacaine
   B. Lidocaine
   C. Prilocaine
   D. Bupivacaine

4. Which of the following anesthetic agents is listed in FDA Pregnancy Category B?
   A. Mepivacaine
   B. Lidocaine
   C. Articaine
   D. Bupivacaine

5. Which of the following anesthetic agents is available in both 2% and 3% concentrations?
   A. Mepivacaine
   B. Lidocaine
   C. Prilocaine
   D. Bupivacaine

6. In patients with clinically significant cardiovascular impairment, the maximum recommended dose of epinephrine is .04 mg of epinephrine or:
   A. 4 cartridges at 1:50,000 dilution
   B. 1 cartridge at 1:200,000 dilution
   C. 1 cartridge at 1:100,000 dilution
   D. 2 cartridges at 1:100,000 dilution

7. Cardiac patients who may be at particular risk for potential cardiovascular events after the delivery of local anesthetics with vasoconstrictor include those with which of the following?
   A. Unstable angina
   B. Recent myocardial infarction
   C. Decompensated heart failure
   D. All of the above

8. Local anesthetic drugs have a direct influence on the myocardium and the peripheral vasculature. As blood levels of anesthetics increase, myocardial stimulation occurs, increasing the electrical excitability of the myocardium as well as the rate of conduction and force of contraction.
   A. The first statement is true and the second statement is false.
   B. The first statement is false and the second statement is true.
   C. Both statements are true.
   D. Both statements are false.

9. In patients with a history of hypertension, the clinician must evaluate which of the following before administering local anesthetic agents?
   A. The controlled or uncontrolled state of blood pressure
   B. The medication(s) the patient may be taking to control blood pressure
   C. Potential drug interactions when integrating local anesthesia into dental care
   D. All of the above

10. Most patients who have suffered an MI within six months or less are considered ASA IV and must receive medical clearance from the cardiologist prior to proceeding with dental treatment of any kind. Patients who have suffered an MI six months or longer are considered an ASA II unless little or no residual damage was noted following the MI, in which the patient would be considered an ASA I.
   A. The first statement is true and the second statement is false.
   B. The first statement is false and the second statement is true.
   C. Both statements are true.
   D. Both statements are false.

11. In patients with angina, all of the following should be considered except:
   A. Nitrous oxide inhalation sedation to reduce stress
   B. Local anesthesia with vasoconstrictor to control perioperative pain
   C. Minimal analgesia to control postoperative pain
   D. None of the above

12. In patients with a thromboembolic disorder, injection techniques involving an increased risk of blood vessel penetration should be avoided. These include all of the following except:
   A. Posterior superior alveolar (PSA) block
   B. Inferior alveolar (IA) block
   C. Infraorbital (IO) block
   D. Periodontal ligament injections

13. The goal in treating a patient with diabetes is to assess and ascertain that the patient's blood glucose is well controlled before the administration of local anesthesia with epinephrine. Epinephrine administration may result in dangerous reductions in blood sugar.
   A. The first statement is true and the second statement is false.
   B. The first statement is false and the second statement is true.
   C. Both statements are true.
   D. Both statements are false.

14. In patients with hyperthyroidism, significant reactions may be prevented or minimized by either avoiding the use of epinephrine or by using minimum effective concentrations. The use of local anesthetic agents with epinephrine is contraindicated in patients with controlled or uncontrolled hyperthyroidism.
   A. The first statement is true and the second statement is false.
   B. The first statement is false and the second statement is true.
   C. Both statements are true.
   D. Both statements are false.

15. Asthma may be induced in the presence of allergy, which may be exacerbated by the integration of ___ found in local anesthetic cartridges containing epinephrine.
   A. Parabens
   B. Sulfites
   C. Sodium lauryl sulfate
   D. Amides

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QUESTIONS

16. Which of the following anesthetic agents undergoes biotransformation via plasma cholinesterases (to a greater extent) as well as liver enzymes (to a lesser extent)?
    A. Mepivacaine
    B. Lidocaine
    C. Articaine
    D. Bupivacaine

17. Patients who have suffered a cerebrovascular accident (CVA) or stroke have a decreased risk for future CVA. Thus, the clinician must ensure the patient receives adequate anesthesia to reduce the risk of pain-induced stress.
    A. The first statement is true and the second statement is false.
    B. The first statement is false and the second statement is true.
    C. Both statements are true.
    D. Both statements are false.

18. Controlled epileptics are ASA II risks while those with greater frequency of seizures may represent ASA III or ASA IV risk. It should be noted that tonic-clonic seizure activity manifests from overdose of local anesthetics.
    A. The first statement is true and the second statement is false.
    B. The first statement is false and the second statement is true.
    C. Both statements are true.
    D. Both statements are false.

19. What is the term used to describe the phobia of needles?
    A. Arachnophobia
    B. Trypanophobia
    C. Acrophobia
    D. Onomatophobia

20. Modifications to local anesthesia delivery for patients taking monoamine oxidase inhibitors include which of the following?
    A. Avoid the delivery of higher doses of anesthetic drugs
    B. Limit doses of epinephrine
    C. Avoid levonordefrin
    D. None of the above

21. Patients with primary adrenal insufficiency lack endogenous cortisol and aldosterone and require daily steroid therapy to replace them. The need for establishing profound anesthesia and preventing pain-induced stress is critical in managing these patients.
    A. The first statement is true and the second statement is false.
    B. The first statement is false and the second statement is true.
    C. Both statements are true.
    D. Both statements are false.

22. The diagnosis of methemoglobinemia provides a contraindication for the administration of all of the following anesthetic agents except:
    A. Topical benzocaine
    B. Injectable prilocaine
    C. Topical lidocaine
    D. None of the above

23. Medications that may induce a methemoglobinemia episode include which of the following?
    A. Phenytoin
    B. Acetaminophen
    C. Sulfonamides
    D. All of the above

24. Patients with ___ have an impairment in metabolizing ester-type anesthetics.
    A. Pseudocholinesterase
    B. Atypical plasma cholinesterase
    C. Typical plasma cholinesterase
    D. Acetylcholinesterase

25. Which trimester of pregnancy is typically considered to be the safest period for dental procedures?
    A. First
    B. Second
    C. Third
    D. Fourth

26. The safety of which of the following anesthetic agents during lactation has not been established?
    A. Articaine
    B. Mepivacaine
    C. Prilocaine
    D. All of the above

27. Manifestations attributable to malignant hyperthermia may include all of the following except:
    A. Tachycardia
    B. Cyanosis
    C. Metabolic acidosis
    D. Flaccidity of the musculature

28. In general, opioids, antianxiety drugs, phenothiazines, and barbiturates produce a depression of the central nervous system. When administered concomitantly, local anesthetics have the potential to reverse this CNS depression.
    A. The first statement is true and the second statement is false.
    B. The first statement is false and the second statement is true.
    C. Both statements are true.
    D. Both statements are false.

29. The administration of local anesthetic agents is absolutely contraindicated within 24 hours of the use of many recreational drugs. Notably, the risks associated with such concomitant use potentially eliciting a medical emergency situation are minimal.
    A. The first statement is true and the second statement is false.
    B. The first statement is false and the second statement is true.
    C. Both statements are true.
    D. Both statements are false.

30. Which of the following drugs is most likely to interact with epinephrine?
    A. Acetaminophen
    B. Tricyclic antidepressants
    C. Sulfonamides
    D. Tetracyclines

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Drugs, diseases, and decisions: The interaction between injectable local anesthetics and systemic diseases

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1. Understand the current scientific literature about the potential complications between injectable local anesthesia and systemic disease.
2. Review injectable local anesthesia considerations in the management of oral pain.
3. Discuss chronic diseases requiring modifications in the delivery of injectable local anesthesia, including cardiovascular disease, diabetes, thyroid disease, respiratory disease, hepatic and renal dysfunction, central nervous system disorders, endocrine disease, and hematologic disorders.
4. Discuss conditions that may require modifications to the delivery of injectable local anesthesia, including allergies, pregnancy, and recreational drug use.
5. Identify specific clinical decision-making strategies in the provision of safe injectable local anesthesia delivery.

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7.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	22.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
8.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	23.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
9.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	24.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
10.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	25.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
11.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	26.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
12.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	27.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
13.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	28.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
14.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	29.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
15.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	30.	Ⓐ	Ⓑ	Ⓒ	Ⓓ

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