

Feature Article

Local Anesthetics

Local Anesthetics and Medically Complex Patients

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abstract

As the population ages and medical science advances, more and more patients with complex medical histories will be seeking care in private dental practices. This paper will review a variety of disease entities as well as potential drug interactions pertinent to the use of local anesthetic agents in medically complex patients.

Through steady advances in medical care, many patients who even a short time ago would not have survived systemic illnesses, or at best would have been confined to their beds or homes, are now active, mobile members of our society. As a result, patients with increasingly complex medical situations are in a position to seek dental treatment in private practice offices. The dentist must be prepared to deliver safe, efficient, and competent dental care by understanding the patient's medical condition and medications. This information must be integrated into the dentist's knowledge of the physiologic stresses of dental procedures and the pharmacology of the medications used in dentistry.

The injection of local anesthetic solutions to achieve anesthesia is one of the most commonly performed dental procedures. Prior to administering any medication, including local anesthetics, it is appropriate for the dentist to take a complete medical history and follow up any questions with the patient or by a consultation with the patient's physician.

Though local anesthetics are remarkably safe at therapeutic doses, the practitioner treating medically complex patients must address two basic concerns pertinent to the use of local anesthetic agents: existing systemic diseases that may be exacerbated by the anesthetic agent and medications that may have adverse interactions with local anesthetic agents. This review will focus on a broad range of medical problems and considerations for the use of local anesthetics in these patient populations.

Cardiovascular Diseases

Local anesthetic agents themselves can affect the cardiovascular system, especially at higher doses. Cardiovascular manifestations are usually depressant and are characterized by bradycardia, hypotension, and cardiovascular collapse, potentially leading to cardiac arrest. The initial signs and symptoms of depressed cardiovascular function commonly result from vasovagal reactions (dizziness and fainting), particularly if the patient is in an upright position.^{1,2} Cardiovascular diseases constituting

contraindications to the use of local anesthetics in general, and to the use of vasoconstrictors in local anesthetics in particular, are often discussed in terms of absolute as opposed to relative contraindications.³ Absolute contraindications for the use of local anesthetics with or without vasoconstrictors in patients with cardiovascular diseases exist only if the patient's condition is determined, by the dentist's review of the health history, to be medically unstable to the degree of posing undue risk to the patient's safety. Dental care should be deferred in these patients until their medical conditions have been stabilized under the care of their physicians. For patients with stabilized cardiovascular diseases, dental treatment may usually be delivered in near routine fashion,⁴ although, as the following sections will emphasize, the amount of vasoconstrictor-containing local anesthetic used may need to be limited and the patient carefully monitored.

Hypertension

It is estimated that more than 50 million people in the United States have high blood pressure or are taking antihypertensive medications.^{5,6} Because lack of compliance is a major problem in medical treatment of hypertensive patients, the dental practitioner is wise to measure blood pressure and evaluate the patient's status at every visit.

The decision regarding whether or not a local anesthetic agent containing vasoconstrictor should be administered to a patient with hypertension or other cardiovascular disease is a common concern amongst dental practitioners. A rational approach to this question is to recall the effects and mechanism of action of the vasoconstrictors. One of the primary effects, and advantages, of vasoconstrictors in dental local anesthetics is to delay the absorption of the anesthetic into the systemic circulation. This increases the depth and the duration of anesthesia while decreasing the risk of toxic reaction. Additionally, the vasoconstrictor provides local hemostasis. Epinephrine and levonordefrin (neocobefrin) are the two vasoconstrictor agents commonly used in dental local anesthetic formulations. Although they do have slightly differing cardiac effects, they carry the same precautions for their use.

There are no absolute contraindications to the use of vasoconstrictors in dental local anesthetics, since epinephrine is an endogenously produced neurotransmitter.⁷ In 1964, the American Heart Association and the American Dental Association concluded a joint conference by stating that "the typical concentrations of vasoconstrictors contained in local anesthetics are not contraindicated with cardiovascular disease so long as preliminary aspiration is practiced, the agent is injected slowly, and the smallest effective dose is administered."⁸ It has long been recommended that the total dosage of epinephrine be limited to 0.04 mg in cardiac risk patients.^{9,10} This equates to approximately two cartridges of 1:100,000 epinephrine-containing local anesthetic. Levonordefrin is considered to be roughly one-fifth as effective a vasoconstrictor as epinephrine and is therefore used in a 1:20,000 concentration. In this concentration, levonordefrin is considered to carry the same clinical risks as 1:100,000 epinephrine.¹⁰ The results of a number of studies¹¹⁻¹⁷ indicate that the use of one to two 1.8 ml cartridges of local anesthetic containing a vasoconstrictor is of little clinical significance for most patients with hypertension or other cardiovascular diseases, and that the benefits of maintaining adequate anesthesia for the duration of the procedure far outweighs the risks.

However, the use of more than two cartridges of local anesthetic with a vasoconstrictor should be considered a relative rather than an absolute contraindication. If, after administering one to two cartridges of vasoconstrictor-containing local anesthetic with careful preliminary aspiration and slow injection, the patient exhibits no signs or symptoms of cardiac alteration, additional vasoconstrictor-containing local anesthetic may be used, if necessary, or local anesthetic without epinephrine can be used. Some practitioners prefer to achieve initial anesthesia with a nonvasoconstrictor-containing

anesthetic agent such as 3 percent mepivacaine or 4 percent prilocaine plain and then use a small amount of local anesthetic with vasoconstrictor to supplement cases of inadequate anesthesia. While this is a viable protocol, a safer choice is to use a minimal amount of vasoconstrictor-containing local anesthetic first and then supplement as necessary with nonvasoconstrictor-containing agents. The advantage of using the epinephrine-containing anesthetic first is that it will minimize blood flow in the injection site, thereby holding the local anesthetic in place, optimizing the anesthetic effect while minimizing the rate of plasma uptake and potential toxicity.¹⁰ Since nonvasoconstrictor-containing local anesthetics produce localized vasodilation, addition of a vasoconstrictor-containing agent after first injecting with a nonvasoconstrictor-containing local anesthetic can be expected to produce increased cardiovascular alterations. The goal should always be to minimize the dosage of local anesthetic with or without vasoconstrictor; but if additional vasoconstrictor will provide improved pain control for the dental procedure, it is not contraindicated.

If a patient has severe uncontrolled hypertension, elective dental treatment should be delayed until his or her physician can get the blood pressure under control. But if emergency dental treatment is needed, the clinician may elect to sedate the patient with valium and use one to two cartridges of local anesthetic with a vasoconstrictor. This dose will have minimal physiologic effect and will provide prolonged anesthesia. The greater risk in such a scenario is that without the epinephrine the anesthesia will wear off too soon and the endogenous epinephrine produced by the patient, because of pain from the dental procedure, will be much greater and more detrimental than the small amount of epinephrine in the dental anesthetic cartridge.^{15,18}

Another concern for the dental practitioner is the possibility of an adverse interaction between the local anesthetic agent and a patient's antihypertensive medication, particularly the adrenergic blocking agents. The nonselective beta-adrenergic drugs, such as propranolol (Inderal), pose the greatest risk of adverse interaction.¹⁹ In these patients, an injection of vasoconstrictor-containing local anesthetic may produce a marked peripheral vasoconstriction, which could potentially result in a dangerous increase in blood pressure due to the pre-existing medication-induced inhibition of the compensatory skeletal muscle vasodilation. This compensatory skeletal muscle vasodilation normally acts to balance the peripheral vasoconstriction effects in nonmedicated patients. The cardioselective beta blockers (Lopressor, Tenormin) carry less risk of adverse reactions. Both classes of beta blockers may increase serum levels of anesthetic solutions due to competitive reduction of hepatic clearance.²⁰ Though these considerations are theoretically important, there is still little risk of a problem if the total dose of anesthetic, with 1:100,000 epinephrine or its equivalent, is limited to one to two 1.8 ml cartridges.

Other antihypertensive medications, such as the central sympatholytic drugs, for example Clonidine and Methyldopa (Aldomet), and the peripheral adrenergic antagonists such as Reserpine as well as the direct vasodilators, may potentiate adrenergic receptor sensitivity to sympathomimetics, resulting in a magnified systemic response to vasoconstrictor-containing anesthetics.¹⁹ However, once again, these medications pose no significant risk as long as the vasoconstrictor-containing anesthetic is limited to one to two 1.8 ml cartridges. An additional reminder to inject vasoconstrictor-containing local anesthetics slowly is appropriate due to the increased risk of injection site ischemia resulting from the potentiated localized vasoconstrictor effect.

Angina Pectoris and Post-Myocardial Infarction

Patients with stable angina without a history of infarction generally have a significantly lower risk of adverse reactions to dental anesthetics than do patients with unstable angina or a history of recent (less than six months prior) myocardial infarction. Stress and anxiety reduction play a crucial role in management of these patients, and excellent pain control throughout the dental procedure is essential.

The use of local anesthetics containing a vasoconstrictor is recommended as part of the stress reduction protocol for these patients (**Table 1**). The dosage of the vasoconstrictor should be limited to that contained in one to two 1.8 ml cartridges of vasoconstrictor-containing anesthetic. For patients with unstable angina, recent myocardial infarction (less than six months), or recent coronary artery bypass graft surgery (less than three months), elective dental treatment should be postponed.³ If emergency treatment is required, stress-reduction protocols with antianxiety agents are appropriate, and the above limitation of one to two cartridges of vasoconstrictor-containing anesthetic must be strictly observed.²¹

Cardiac Dysrhythmia

Proper identification of patients with an existing cardiac dysrhythmia, commonly called arrhythmias, or those patients who may be prone to developing dysrhythmia, is essential and requires a physician consult to determine the current status. Patients with coronary atherosclerotic heart disease, ischemic heart disease, or congestive heart failure are susceptible to stress-induced cardiac dysrhythmias. Stress- and anxiety-reduction protocols are again of paramount importance. Local anesthetic agents containing vasoconstrictors are appropriate for maintenance of adequate pain control during dental procedures. Elective dentistry should be avoided in patients with severe or refractory dysrhythmias until their physician can get the problem under control. Once again, it is reasonable and safe to limit the total dose of local anesthetic to no more than two 1.8 ml cartridges per appointment.¹⁹ The use of periodontal ligament or intraosseous injections using a vasoconstrictor-containing local anesthetic is not recommended in these patients.²²

Congestive Heart Failure

Patients who are under physician care and well-controlled with no complications can be treated relatively routinely. Limitation of vasoconstrictor dosage to two 1.8 ml cartridges of vasoconstrictor-containing anesthetic is advised. Patients taking digitalis glycosides, such as digoxin, should be carefully monitored if vasoconstrictors are used since interaction of the two drugs may precipitate dysrhythmias. Additionally, patients taking long-acting nitrate medications, such as nitroglycerin, Isordil, or Isorbid, or taking a vasodilator medication such as Minipres may show decreased effectiveness of the vasoconstrictor in local anesthetics, and therefore shorter anesthesia duration.²¹

Cerebrovascular Accident

Atherosclerosis, hypertensive vascular disease, and cardiac pathoses such as myocardial infarction and atrial fibrillation are commonly associated with the occurrence of strokes. A patient who has suffered a stroke is at greater risk for having another one than is a patient who has never had one. It is recommended that dental treatment be deferred for six months following a stroke because of the increased risk of recurrent strokes during this period. After six months, dental procedures may be provided with the use of vasoconstrictor-containing local anesthetics where required for adequate pain control. If the stroke patient has associated cardiovascular problems, the dosage of local anesthetic with vasoconstrictor should be minimized in accordance with the guidelines for their specific cardiovascular disease.²¹

Pulmonary Disease

The most common pulmonary diseases encountered in the dental office are asthma, tuberculosis, and chronic obstructive pulmonary disease, which includes chronic bronchitis and emphysema. While the status of tuberculosis infection in a patient is of the utmost concern to dental practitioners, and the

patient's infection must be under control before elective dentistry is done, it poses no implications with regard to the use of dental local anesthetics.

Asthma

Dental management of asthmatic patients is primarily aimed at prevention of an acute asthma attack. Knowing that stress may be a precipitating factor in asthma attacks, adherence to stress-reduction protocols is again essential and implies the judicious use of local anesthetics containing vasoconstrictors when the planned procedure requires extended depth and duration of anesthesia. However, caution has been recommended based upon Food and Drug Administration warnings that drugs containing sulfites can be a cause of allergic reactions in susceptible individuals.²³ Studies suggest that sodium metabisulfite, which is used as an antioxidant agent in dental local anesthetic solutions containing vasoconstrictors to prevent the breakdown of the vasoconstrictor, may induce allergic, or extrinsic, asthma attacks.²⁴ Data on the incidence of this problem occurring is limited, and suspicion is that it is probably not a common reaction even in sulfite-sensitive patients since the amount of metabisulfite in dental anesthetics is quite small. Indications are that more than 96 percent of asthmatics are not sensitive to sulfites at all; and those who are sensitive are usually severe, steroid-dependent asthmatics.²⁵ As Perusse and colleagues conclude, "we believe local anesthetic with vasoconstrictor can be used safely for nonsteroid-dependent asthma patients. However, until we know more about the sulfite sensitivity threshold, we recommend avoiding local anesthetic with vasoconstrictors in corticosteroid-dependent asthma patients on account of a higher risk of sulfite allergy and the possibility that an accidental intravascular injection might cause a severe and immediate asthmatic reaction in the sensitive patient."²⁶

Chronic Obstructive Pulmonary Disease

The two most common forms of chronic obstructive pulmonary disease, characterized by chronic irreversible obstruction of ventilation of the lungs, are chronic bronchitis and emphysema. Patients with chronic obstructive pulmonary disease already have decreased respiratory function, making it mandatory that the dental practitioner take every precaution to avoid further respiratory depression. There are no contraindications to the use of therapeutic doses of local anesthetics in these patients. However, any patient with chronic obstructive pulmonary disease who also suffers from coronary heart disease and/or hypertension must be managed in accordance with the guidelines provided for those diseases.

Renal Disease

In general, drugs excreted by the kidney, such as dental local anesthetics, may not be metabolized and cleared from the blood stream as quickly as normal in the presence of renal disease. Total anesthetic dosage may need to be reduced and the interval of time between subsequent injections may need to be extended. Though this is a consideration, it is not a factor in most dental procedures provided the total local anesthetic dosage is kept to a safe minimum.¹⁰

Hepatic Disease

For patients with known liver function impairment, drugs metabolized by the liver should be avoided if possible, or the dosage at least decreased. Since all of the amide local anesthetics are primarily metabolized in the liver, the presence of liver disease and the status of liver function are important to the dentist.²⁷ A history of hepatitis infection is not uncommon in most dental office patient pools. In

completely recovered patients, local anesthetics may be administered routinely. However, patients with chronic active hepatitis or with carrier status of the hepatitis antigen must be medically evaluated for impaired liver function. Local anesthetics may be used in these patients, but it is recommended that the dose be kept to a minimum.

In patients with more advanced cirrhotic disease, metabolism of local anesthetics may be significantly slowed, leading to increased plasma levels and greater risk of toxicity reactions. Total anesthetic dosage may need to be reduced and the interval of time between subsequent injections may need to be extended. In these cases, initial injection with rapid-onset anesthetics such as lidocaine or mepivacaine followed by injection with a long-acting anesthetic like etidocaine or bupivacaine may be the best protocol for limiting total anesthetic dosage while achieving adequate pain control duration.

Cimetidine (Tagamet) has been shown to significantly reduce the metabolic clearance of amide local anesthetics through the liver. However, the probability of cimetidine and therapeutic doses of local anesthetic interacting to produce a toxic level of local anesthetic in the blood stream is unlikely and unreported.⁷ Other histamine H₂-receptor antagonist drugs such as ranitidine (Zantac) or famotidine (Pepcid) do not share cimetidine's metabolic inhibition of liver enzymes.

Pancreatic Disease

Diabetes

Patients with either Type I insulin-dependent diabetes mellitus or Type II non-insulin-dependent diabetes mellitus, can generally receive local anesthetics without special precautions if control of their disease is well-managed.²⁶ Consultation with a patient's physician, as well as frank discussion with the patient, can determine the current status and what, if any, precautions are needed. Stress-reduction protocols, including excellent pain control, are of paramount importance and use of local anesthetics with vasoconstrictors is recommended when appropriate as long as the dosage is kept to the minimum needed. Special caution should be used for patients with Type I diabetes who are being treated with large doses of insulin. Some of these patients, so-called brittle diabetics, experience dramatic swings between hyperglycemia and hypoglycemia; and the use of vasoconstrictors should be minimized due to the potential for vasoconstrictor-enhanced hypoglycemia.²¹

Adrenal Disease

Adrenal Insufficiency

No alteration of local anesthetic use is required for patients with adrenal insufficiency. Of greatest concern for treatment of these patients is the maintenance of good anesthesia during the dental procedure and good postoperative pain control to reduce stress.

Pheochromocytoma

The cardinal symptom of this tumor of the adrenal medulla or of the sympathetic paravertebral ganglia is hypertension due to the increased secretion of endogenous epinephrine from these tissues. These patients are also prone to cardiac dysrhythmias. Due to the risk of potentiating cardiovascular problems, the use of vasoconstrictor-containing local anesthetics is contraindicated in these patients.²⁶ No elective dental treatment should be rendered until the disease is medically corrected.

Thyroid Disease

Hyperthyroidism

The use of epinephrine or other vasoconstrictors in local anesthetics should be avoided, or at least minimized to one to two cartridges, in the untreated or poorly controlled hyperthyroid patient.²⁶ Hypertension and cardiac abnormalities, especially dysrhythmias, are common in the presence of excessive thyroid hormones. However, the well-managed or euthyroid patient presents no problem and may be given normal concentrations of vasoconstrictors.

Hypothyroidism

In general, the patient with mild symptoms of untreated hypothyroidism is not in danger when receiving dental treatment. However, patients with mild to severe hypothyroidism may have exaggerated responses to local anesthetics due to the central nervous system depressant effects. Dosage should be kept to a minimum in mild hypothyroid patients, and dental treatment is best deferred in severe hypothyroidism until the patient's condition can be corrected by his or her physician.²¹

Musculoskeletal Diseases

Malignant Hyperthermia

This rare, but potentially fatal, muscle disease was at one time believed to be induced by administration of amide local anesthetics. However, leading authorities, including the Malignant Hyperthermia Association of the United States, do not advise any special precautions for the use of amide anesthetics in patients susceptible to malignant hyperthermia.^{28,29}

Blood Dyscrasias

Sickle Cell Anemia

Profound anesthesia as part of a proper stress reduction protocol is essential in management of these patients. The use of vasoconstrictor-containing local anesthetics is considered safe as long as the dosage is limited to one to two cartridges.³⁰

Methemoglobinemia

Methemoglobin is hemoglobin that has been oxidized and can no longer bind and transport oxygen. While present in everyone, it normally makes up less than 1 percent of the circulating red blood cells. Increases in methemoglobin levels can be induced by administration of local anesthetic solutions, particularly prilocaine (Citanest), usually when in combination with other medications that also increase the methemoglobin level.^{20,31} Examples of common medications that may produce this interaction are Cipro, Bactrim, Septra, Dapsone, Macrochantin, Macrobid, Isordil, Nardil, and nitroglycerin.³² Patients with methemoglobinemia or taking medications associated with this disease may be safely treated with local anesthetic injections, with or without vasoconstrictors; however, the dosage should be minimized and the use of prilocaine should be avoided.

Drug Interactions

Antipsychotic Drugs (Phenothiazines)

There are no contraindications for use of any local anesthetics, with or without vasoconstrictors, in patients taking lithium for bipolar disease. For bipolar patients taking a phenothiazine type of drug such as chlorpromazine (Thorazine) or risperidone (Risperdal), fluctuations in blood pressure are common. Local anesthetics with vasoconstrictors used in normal amounts usually will produce no adverse effects.³³ However, consultation with the patient's physician is recommended before dental treatment, and the patient should be carefully monitored for possible hypotensive episodes during the appointment.³⁵

Cocaine

The main concern in patients abusing cocaine is the significant danger of myocardial ischemia, cardiac dysrhythmias, and hypertension. Patients high on cocaine should not be treated in the dental office for a minimum of six hours following the last administration of cocaine,³⁴ although the longer the time since the last use of the drug the better, with some researchers recommending deferral of dental treatment for 24 to 72 hours.^{7,33,35}

Tricyclic Antidepressants

Although use of tricyclic antidepressant drugs such as imipramine (Tofranil) and amitriptyline (Elavil) is decreasing, they are still prescribed to significant numbers of patients. One to two cartridges of epinephrine-containing local anesthetic can be safely used in patients taking these drugs, however, these patients should be carefully observed at all times for signs of hypertension due to enhanced sympathomimetic effects.³³ Levonordefrin-containing local anesthetics are not recommended due to a greater tendency toward hypertension producing receptor potentiation than is seen with epinephrine.^{33,35}

Monoamine Oxidase Inhibitors

Dentists have long been cautioned about potential interactions of drugs of this class, for example the antidepressant phenelzine (Nardil), the Parkinson's disease drug selegiline (Eldapryl), and the antimicrobial furazolidone (Furoxone), relative to vasoconstrictor-containing local anesthetics.³³ These cautions were based upon a fear of induction of severe hypertension due to interaction of vasoconstrictor-containing anesthetics with the MAO inhibitors. However, both animal and human studies have failed to yield evidence of such an interaction.²⁸ Vasoconstrictor-containing local anesthetics may be used without special precautions in patients taking MAO inhibitor drugs.^{29,36}

Antianxiety Drugs

Diazepam (Valium), one of the most widely prescribed drugs in the United States, is a potent central nervous system depressant. Dosage of all local anesthetic agents should be kept to the minimum necessary for good pain control in patients taking benzodiazepine antianxiety drugs due to their additive depressive effects.²⁰

Summary

Local anesthetics, with or without vasoconstrictors, may be safely used in most medically complex

patients. Observance of simple safety guidelines should be universal for administration of local anesthetics to all patients:

- * Aspirate carefully before injecting to reduce the risk of unintentional intravascular injection;
- * Inject slowly, a maximum rate of one minute per carpule is widely recommended,^{10,29} and monitor the patient both during and after the injection for unusual reactions;
- * Select the anesthetic agent and whether to use it with or without a vasoconstrictor based upon the duration of anesthesia appropriate for the planned procedure; and
- * Use the minimum amount of anesthetic solution that is needed to achieve an adequate level of anesthesia to keep the patient comfortable throughout the dental procedure.

Adherence to these simple guidelines will reduce the risk of adverse reactions to the local anesthetic agents themselves or to the vasoconstrictors contained in local anesthetics. A further safety guideline useful for the majority of medically complex patients is to reduce the amount of local anesthetic containing a vasoconstrictor to no more than two 1.8 ml cartridges. If additional anesthetic volume is need to maintain adequate pain control for the procedure, nonvasoconstrictor anesthetics can be used for subsequent injections. However, the use of additional cartridges of vasoconstrictor-containing local anesthetics is not an absolute contraindication in patients who show no sensitivity to vasoconstrictor agents in local anesthetics. **Table 2** summarizes the use of local anesthetic agents for many disease and drug situations encountered in medically complex dental patients.

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Table 1. Stress Reduction Protocol

- * Morning appointments are usually best.
- * Keep appointments as short as possible.
- * Freely discuss any questions, concerns, or fears that the patient has.

- * Establish an honest, supportive relationship with the patient.
- * Maintain a calm, quiet, professional environment.
- * Provide clear explanations of what the patient should expect and feel.
- * Premedicate with benzodiazepines if needed.
- * Ensure good pain control through judicious selection of local anesthetic agents appropriate for maintenance of patient comfort throughout the procedure.
- * Use nitrous oxide as needed (avoid hypoxia).
- * Use gradual position changes to avoid postural hypotension.
- * End the appointment if the patient appears overstressed.

Table 2. Summary of Local Anesthetic Use in Medically Complex Patients

DISEASE	PRECAUTIONS
Cardiovascular disease	Use stress-reduction protocol.
* Hypertension (controlled)	Minimize vasoconstrictor use.
Nonselective beta-blockers (propranolol)	Avoid vasoconstrictors.
Selective beta-blockers (Lopressor)	Minimize vasoconstrictor use.
Other antihypertensive drugs (Clonidine, Aldomet, Reserpine)	Minimize vasoconstrictor use; monitor for injection site ischemia.
* Angina and post-myocardial infarction	Minimize vasoconstrictor use.
* Cardiac dysrhythmia (refractory)	Minimize vasoconstrictor use; avoid PDL & intraosseous injections.
* Congestive heart failure (controlled)	Minimize vasoconstrictor use.
Digitalis glycosides (Digoxin)	Monitor for arrhythmias if using vasoconstrictor.
Long-acting nitrates and vasodilators (Nitroglycerin, Isordil, Minipres)	Watch for decreased anesthetic duration.
* Cerebrovascular accident (stroke)	No special precautions.
Pulmonary Disease	
* Asthma	Stress reduction protocol; minimize vasoconstrictor use.
* Chronic obstructive pulmonary disease	No special precautions.
Renal Disease (severe)	Reduced dosage; extend time between injections.

Hepatic Disease (severe)	Reduced dosage; extend time between injections
Pancreatic Disease	
* Diabetes	Stress-reduction protocol.
Adrenal Disease	
* Adrenal insufficiency	Stress-reduction protocol.
* Pheochromocytoma	Avoid vasoconstrictors.
Thyroid Disease	
* Hyperthyroidism (controlled or euthyroid)	No special precautions.
* Hypothyroidism (mild)	No special precautions.
Musculoskeletal Disease	
* Malignant hyperthermia	No special precautions.
Blood Dyscrasias	
* Sickle cell anemia	Stress reduction protocol; minimize vasoconstrictor use.
* Methemoglobinemia	Avoid prilocaine (Citanest).
DRUG INTERACTIONS	PRECAUTIONS
Antipsychotic drugs (Thorazine)	No special precautions.
Cocaine	Delay treatment for six to 72 hours.
Tricyclic antidepressants (Elavil)	Minimize epinephrine; avoid levonordefrin.
Monoamine oxidase inhibitors	No special precautions.
Antianxiety drugs (benzodiazepines)	Minimize all anesthetics.



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