

## FROM THE ACADEMY

## Guidelines for the use of local anesthesia in office-based dermatologic surgery

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There are an increasing number and variety of dermatologic surgical procedures performed safely in the office setting. This evidence-based guideline addresses important clinical questions that arise regarding the use and safety of local anesthesia for dermatologic office-based procedures. In addition to recommendations for dermatologists, this guideline also takes into account patient preferences while optimizing their safety and quality of care. The clinical recommendations presented here are based on the best evidence available as well as expert opinion. (J Am Acad Dermatol <http://dx.doi.org/10.1016/j.jaad.2016.01.022>.)

**Key words:** anesthesia; clinical guideline; dermatology; education; epinephrine; infiltration; local anesthesia; local nerve block; office-based surgery; pain; safety; topical; tumescent.

### DISCLAIMER

Adherence to these guidelines will not ensure successful treatment in every situation. Furthermore, these guidelines should not be interpreted as setting a standard of care, or be deemed inclusive of all proper methods of care, nor exclusive of other methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding the propriety of any specific therapy and/or technique must be made by the physician and the patient in light of all the circumstances presented by the individual patient, and the known variability and biological behavior of the disease. This guideline reflects the best available data at the time the guideline was prepared. The results of future studies

may require revisions to the recommendations in this guideline to reflect new data.

### SCOPE

This guideline addresses the clinical use and safety of local anesthetics (ie, topical, infiltrative, nerve blocks, and infiltrative tumescent) commonly used in office-based dermatologic surgery for adult and pediatric patients. While anxiolytics, sedatives, and other systemic medications may be used for office-based procedures, these methods are not discussed in this guideline because they are forms of systemic and not local anesthesia. Anesthetic toxicity is rare in the dermatologic office setting, and therefore management of local anesthetic

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toxicity is not addressed in this guideline. Other aspects, such as physician and staff certification, credentialing and privileging, facility accreditation, office equipment and set-up requirements, and legal/regulatory compliance, or any other administrative requirements and regulations, fall beyond the scope of this guideline.

## METHODS

A work group composed of 8 dermatology experts practicing in office settings and in academic institutions, 1 anesthesiologist, and 1 patient advocate was convened to determine the scope of the guideline, and to identify important clinical questions (Table 1) in the use and safety of local anesthesia in office settings. Work group members completed a disclosure of interests, which was periodically updated and reviewed throughout guideline development. If a potential conflict was noted, the work group member recused him or herself from discussion and drafting of recommendations pertinent to the topic area of the disclosed interest.

Evidence was obtained for the clinical questions determined by the work group using a systematic search of PubMed and Google Scholar databases between the years of 1960 and 2014. Searches were prospectively limited to publications in the English language. MeSH terms and strings used in the literature search included: dermatology, skin, office-based surgery, local anesthesia, infiltration, topical anesthesia, lidocaine, tetracaine, prilocaine, marcaine, bupivacaine, etidocaine, mepivacaine, procaine, ester, amide, structure, comparison, efficacy, safety, risk, nerve blocks, tissue, face, head, neck, nose, ear, eye, lid, hands, feet, digits, penis, genitals, pregnancy, pediatrics, pain, tissue absorption, dose, time, slow, fast, volume, pharmacokinetics, serum levels, technique, method, laser, ethyl chloride, symptoms, systemic, toxicity, local anesthetic systemic toxicity (LAST), treatment, prevention, epinephrine, adrenaline, vasoconstriction, hyaluronidase, mixtures, solution, needle, cannula, sodium bicarbonate, pH, infusion rate, and tumescent anesthesia.

A total of 599 abstracts were initially assessed for possible inclusion. After removal of duplicate data and nonrelevant studies, 165 abstracts were retained and used for a secondary, manual search identifying 36 additional relevant studies. Once the full data set of 201 studies was collated, each study was reviewed and ranked based on relevance and the level of evidence for the outlined clinical questions. Evidence tables were generated for these studies and used by the work group in developing recommendations.

The available evidence was evaluated using a unified system called the Strength of Recommendation

Taxonomy (SORT) that was developed by editors of the United States family medicine and primary care journals (ie, *American Family Physician*, *Family Medicine*, *Journal of Family Practice*, and *BMJ USA*).<sup>1</sup> Evidence was graded using a 3-point scale based on the quality of methodology (eg, randomized control trial, case control, prospective or retrospective cohorts, case series, etc) and the overall focus of the study (ie, diagnosis, treatment, prevention, screening, or prognosis) as follows:

- I. Good-quality patient-oriented evidence (ie, evidence measuring outcomes that matter to patients, including morbidity, mortality, symptom improvement, cost reduction, and quality of life).
- II. Limited-quality patient-oriented evidence (ie, lower quality clinical trials, cohort studies, and case control studies).
- III. Other evidence including consensus guidelines, opinion, case studies, or disease-oriented evidence (ie, evidence measuring intermediate, physiologic, or surrogate end points that may or may not reflect improvements in patient outcomes).

Clinical recommendations were developed based on the best available evidence tabled in the guideline. The strength of recommendation was ranked as follows:

- A. Recommendation based on consistent and good-quality patient-oriented evidence.
- B. Recommendation based on inconsistent or limited-quality patient-oriented evidence.
- C. Recommendation based on consensus, opinion, case studies, or disease-oriented evidence.

In situations where documented evidence-based data were not available, or showing inconsistent or limited conclusions, expert opinion and medical consensus were used to generate clinical recommendations.

This guideline has been developed in accordance with the American Academy of Dermatology (AAD)/AAD Association Administrative Regulations for Evidence-based Clinical Practice Guidelines (version approved August 2012), which includes the opportunity for review and comment by the entire AAD membership and final review and approval by the AAD Board of Directors.<sup>2</sup> This guideline will be considered current for a period of 5 years from the date of publication, unless reaffirmed, updated, or retired at or before that time.

## DEFINITION

The definition of office-based surgery varies by state and regulatory agency. For the purpose of this

**Table I.** Clinical questions used to structure the evidence review for the use of local anesthesia in the office-based setting**Topical anesthesia**

- A. Is topical anesthesia safer/more effective than other types of anesthesia to reduce pain?
- B. Are the same topical anesthetics used in adults also recommended/safe in pregnancy and lactation?
- C. Are the same topical anesthetics used in adults also recommended/safe in children?

**Local infiltration anesthesia**

- A. Is local infiltration anesthesia safer/more effective than other types of anesthesia to reduce pain?
- B. Does the method to calculate the maximum anesthetic doses change when infiltrated anesthetics are delivered over an extended time period compared to a short time period?
- C. Do the local anesthetic serum levels change based on the method of delivery?
- D. Is there a measure of care better/safer than others in decreasing the symptoms of systemic toxicity?
- E. Does the addition of epinephrine to infiltrated anesthetics increase safety risks in cardiac and pregnant patients, or for use in the digits, nose, and penis, compared to infiltrated anesthetics alone?
- F. Is a lower concentration of epinephrine as effective as high concentrations added to infiltrated anesthetics to produce vasoconstriction?
- G. Do the maximum recommended doses and delivery methods both in adults and children differ by the addition of epinephrine?
- H. Does the addition of hyaluronidase increase the diffusion rate and effectiveness/safety of infiltrative anesthetics?
- I. Does mixing multiple anesthetics pose a benefit to the patient compared to a single anesthetic for the same procedure?
- J. Does the addition of sodium bicarbonate to anesthetics decrease patients' pain when administered by subcutaneous infiltration?
- K. Does the use of a particular injection represent a clinical benefit for the patient?
- L. Does the use of other commonly used techniques minimize pain?

**Nerve block/regional anesthesia**

- A. Does nerve block/regional anesthesia represent a clinical benefit over local infiltrative anesthesia for the head and neck, hands, feet, and genitals?
- B. Does the injection of local anesthesia in the optimal entry points for the head and neck, hands, feet, and genitals pose an increased risk of nerve damage from needle trauma and of toxicity?

**Tumescent anesthesia**

- A. Is the use of lidocaine in tumescent anesthesia safer than other anesthetics for the same procedure?
- B. Does the volume and dose of lidocaine and epinephrine correlate with patient safety in tumescent anesthesia?
- C. Does a slow infusion rate result in less pain or a better anesthetic effect than fast infusion rates?
- D. Is there a measure of care better/safer than others to decrease symptoms of local anesthetic systemic toxicity for patients anesthetized using the tumescent technique?

clinical guideline, office-based dermatologic surgery is defined as surgery performed by a licensed physician to diagnose and treat certain skin conditions using topical, local, infiltrative, or tumescent local anesthesia in an office or facility outside of ambulatory surgical centers and hospital settings.

**INTRODUCTION**

There are a large variety of skin conditions that require surgical intervention for proper diagnosis and management. Most, if not all, of these procedures may be safely performed in the dermatology office with the patient under local anesthesia.<sup>3,4</sup> A myriad of medications and techniques are available for use, and selection of local anesthesia is largely based upon the experience and comfort level of the clinician, but is also impacted by patient factors and concerns. Certain patient populations, such as those with red hair or African Americans, seem to be more sensitive to pain and to require higher doses to

achieve similar anesthesia, with the concomitant increased risk of adverse effects.<sup>5-8</sup> A list of local anesthetics for use in the office setting is provided in [Tables II](#) and [III](#). This guideline is created to facilitate the selection of the most effective means of achieving local anesthesia for a variety of cutaneous procedures while also minimizing the risk of adverse events. In cases where clinical evidence to make a recommendation is insufficient or lacking, the experience of the expert panel is presented and gaps in data are identified in order to guide future research.

**TOPICAL ANESTHESIA**

The recommendations for topical anesthesia and the strength of evidence are listed in [Tables IV](#) and [V](#), respectively.

**Safety and efficacy**

Many topical anesthetic agents are effective and safe for use in dermatologic procedures with a low

**Table II.** Anesthetics used for local infiltration<sup>3,9-11</sup>

Anesthetic	Onset (min)	Duration (min)		Maximal recommended dose for adults	
		Without epinephrine	With epinephrine	Without epinephrine	With epinephrine
<b>Amides</b>					
Articaine	2-4	30-120	60-240	5.0 mg/kg or 350 mg	7.0 mg/kg or 500 mg
Bupivacaine	2-10	120-240	240-480	2.5 mg/kg or 175 mg	3.0 mg/kg or 225 mg
Etidocaine	3-5	200	240-360	4.5 mg/kg or 300 mg	6.5 mg/kg or 400 mg
Lidocaine	<1	30-120	60-400	4.5 mg/kg or 300 mg	7.0 mg/kg or 500 mg
Mepivacaine	3-20	30-120	60-400	6.0 mg/kg or 400 mg	7.0 mg/kg or 550 mg
Prilocaine	5-6	30-120	60-400	7.0 mg/kg or 400 mg	10.0 mg/kg or 600 mg
<b>Esters</b>					
Chloroprocaine	5-6	30-60	N/A	11.0 mg/kg or 800 mg	14.0 mg/kg or 1000 mg
Procaine	5	15-90	30-180	10.0 mg/kg	14.0 mg/kg
Tetracaine	7	120-240	240-480	2.0 mg/kg	2.0 mg/kg

**Table III.** Anesthetics for topical use<sup>10,11</sup>

Anesthetic	Onset (min)	Duration (min)	Special considerations
Benzocaine	<5	15-45	Methemoglobinemia possible
Cocaine	1-5	30-60	
Dibucaine	<5	15-45	For mucous membranes
Dyclonine	2-10	<60	For mucous membranes but not conjunctiva
Lidocaine	<2	30-45	
Lidocaine/prilocaine eutectic mixture	<60	60-120 after removal of occlusive dressing	Only for use on intact skin, methemoglobinemia possible

risk of adverse events.<sup>13,34,35</sup> However, caution must be taken when occlusion is used or large surface areas are treated because there are no data supporting standard practice. This is particularly true with compounded mixtures and nonstandard doses, which although rarely used by dermatologists may increase the risk of adverse events and even death.<sup>36-38</sup> Data comparing these agents in dermatology are limited to 1 prospective study that found 4 topical preparations to be equivalent in reducing pain sensation for use in nonablative laser therapy.<sup>39</sup> More extensive research has been conducted in emergency and obstetric settings, which has also shown multiple topical anesthetics to be equally effective for wound repair.<sup>12,15,16</sup>

The advent of many effective noncocaine formulations in the 1990s has raised the question of whether the use of cocaine in topical anesthesia is necessary. A systematic review of 22 trials encompassing >3000 patients was conducted to identify noncocaine anesthetics that were potentially less costly yet equally effective as those that contain cocaine.<sup>12</sup> The review found no significant difference in efficacy among topical tetracaine-epinephrine-cocaine and 6 different cocaine-free formulations, but the addition of cocaine was associated with a higher cost and potential for adverse

effects. Although no firm recommendation supporting the use of any single noncocaine formulation over another can be made, it is the opinion of this work group that because of the increased cost and potential for adverse events, noncocaine anesthetics are preferred over those containing cocaine for use in office-based dermatologic surgery.

In certain situations, topical agents may offer similar analgesia to that of infiltrated anesthetics. Studies comparing topical to infiltrative anesthesia, including a systematic review, found the 2 methods to have equivalent efficacy in episiotomy repair, split-thickness skin graft harvest, manipulation of the fractured nose, arterial cannulation, and minor laceration repair.<sup>12,15-19</sup> For the latter indication, topical agents were particularly useful for face and scalp wounds, where absorption may be highest.<sup>19</sup> Most of these studies noted more patient discomfort associated with the injection of infiltration anesthesia than the application of topical anesthetic. In addition, single studies found topical anesthesia alone to be sufficient for cauterization or excision of genital warts in 97% of men (55 of 57 patients)<sup>20</sup> and of skin lesions  $\leq 40$  mm in diameter on the trunk or extremities in 87% of adults (92 of 106 patients)<sup>21</sup>—although the degree of repair was not stated. Extrapolation from these data suggests that topical anesthesia alone may

**Table IV.** Recommendations for the use of topical anesthesia in dermatologic surgery

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Noncocaine formulations are preferred over cocaine formulations and recommended for use in office-based procedures

Topical agents are recommended as a first-line method of anesthesia for nonablative laser treatments

Topical anesthesia can be used for performing office-based procedures, such as skin biopsy, small excisions, and filler and botulinum toxin injections

The use of topical anesthetic agents is recommended to lessen the pain of injection and reduce the dose of infiltration anesthesia needed for larger procedures

Topical lidocaine is safe for use on pregnant or nursing women, but there is insufficient evidence to recommend use of other topical anesthetics

Elective procedures and those not of urgent medical necessity requiring topical lidocaine in pregnant women should be postponed until after delivery

Procedures of urgent medical necessity should be delayed until at least the second trimester when possible

Topical agents are recommended as a first-line method of anesthesia for the repair of dermal lacerations in children and for other minor dermatologic procedures, including curettage. For skin biopsy, excision, or other cases where topical agents alone are insufficient, adjunctive use of topical anesthesia to lessen the discomfort of infiltrative anesthesia should be considered

For more extensive surgery, the combination of topical and infiltration anesthesia should be considered as an alternate to sedation or general anesthesia in pediatric patients

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**Table V.** Strength of recommendations for use of topical anesthesia in dermatologic surgery

Recommendation	Strength of recommendation	Level of evidence	References
Use of noncocaine topical anesthetics	A	II	12
Topical anesthesia as the first-line method for nonablative laser treatments	C	III	13,14
Topical anesthesia for use in minor skin procedures in adults	C	III	13-21
Topical anesthesia to reduce the pain of local anesthetic injection	C	III	Expert opinion
Use of limited amounts of topical lidocaine in pregnant and nursing women	C	III	22-25
Postpone use of topical anesthesia until after delivery or second trimester when possible	C	III	Expert opinion
Against use of nonlidocaine topical anesthetics in pregnant or nursing women	C	III	Expert opinion
Use of topical anesthesia as the first-line method for repair of dermal lacerations in children	A	I, II	19,26-31
Use of topical anesthesia as the first-line method for other minor procedures in children	C	III	Expert opinion
Adjunctive use of topical anesthesia to minimize discomfort of infiltrative anesthesia in children	C	III	Expert opinion
Topical and infiltrative anesthesia used as an alternate to sedation and general anesthesia in children	C	III	19,26-33

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be acceptable for minor skin surgeries and can be considered as an alternate to infiltration anesthesia.

The area in which topical anesthesia is perhaps most consistently used in dermatology is for cutaneous laser procedures. In the experience of the work group, topical agents achieve anesthesia that is adequate for a variety of nonablative laser treatments. Expert experience and limited data from the literature suggest that topical anesthesia alone may even be sufficient to perform ablative laser resurfacing for

some patients, but more often is used in combination with infiltrative anesthesia or cutaneous nerve blocks in these procedures.<sup>13,14</sup> In the opinion of the expert panel, topical anesthesia is also helpful to enhance patient comfort during injections of subcutaneous filler and botulinum toxin. In cases where infiltration anesthesia is necessary, the experience of the work group supports the adjunctive use of topical agents to reduce the effective dose and the pain of injection of local anesthetic.



Further study into the use of these agents would be helpful to elucidate the effects of occlusion, iontophoresis, and other methods of augmenting delivery on the efficacy and side effects of topical anesthetics.<sup>40</sup> Additional randomized controlled trials examining the effectiveness of topical anesthesia for dermatologic procedures are also needed.

### **Pregnancy and lactation**

There are currently no data available relevant to the clinical questions formulated on the use of topical anesthesia in pregnant or nursing women. Animal studies have revealed no evidence of harm to the fetus with infiltrated lidocaine.<sup>22</sup> Based on these reports, the US Food and Drug Administration rates lidocaine as a pregnancy category B medication, and based on this and other evidence, it is considered safe in small amounts for local injection during pregnancy.<sup>22-24</sup> No adverse effects were observed in infants of mothers breastfeeding after epidural anesthesia with lidocaine, and the American Academy of Pediatrics classifies lidocaine as compatible with lactation.<sup>25,41</sup> While data regarding the safety of topical anesthetic use in pregnancy are lacking, the authors recognize that the potential to conduct further studies in this population is limited by ethical constraints. Evidence supports the use of infiltrated lidocaine, and the serum levels of even high concentrations of topical lidocaine in nonpregnant women are low,<sup>24,34,35</sup> and it is therefore this work group's opinion that the drug is also safe for topical application on women who are pregnant or nursing. During pregnancy it is recommended that the medication be reserved for procedures of urgent medical necessity, and those that are not urgent should be postponed until after delivery or delayed until the second trimester when possible (to ensure that fetal organogenesis is complete). There are no data available on the safety of agents other than lidocaine, and their use during pregnancy and lactation is not recommended.

### **Use in children**

Topical anesthetics are considered safe for use in children when dosed properly. The risk of toxicity, although rare, is increased by differences in children's body surface area (BSA) relative to weight and by a lack of linear relationship between BSA and drug exposure or response.<sup>42</sup> Potential adverse effects include methemoglobinemia with application of eutectic mixtures of lidocaine and prilocaine (equal mixtures of the 2 solid compounds by weight, which forms an oil above 18°C), and symptoms of local anesthetic systemic toxicity (LAST) described below, which may occur from any topical anesthetic.

The recommendations for use provided in the package insert for each specific medication should be followed to avoid these complications.

Several investigations conducted in the emergency room have illustrated the effectiveness of topical anesthesia for laceration repair in the pediatric population.<sup>19,26-31</sup> A variety of agents and combinations are useful, although the addition of cocaine does not offer a clear benefit.<sup>12,28,29,31</sup> While studies in the dermatologic literature are sparse, the members of the work group routinely find that non-ablative laser and other minor procedures (ie, curettage) may be performed in children under topical anesthesia. There are no studies comparing the utility of topical and infiltrative anesthesia for these procedures. The only head-to-head trial of these methods found the eutectic mixture of lidocaine and prilocaine to control postoperative pain from inguinal herniotomy equally as well as infiltrated lidocaine.<sup>43</sup>

Because of the scarcity of available evidence, consideration was therefore given to the patient experience when developing recommendations for the use of anesthesia when performing minimally invasive procedures in children. The pain of administering infiltration anesthesia, coupled with the anxiety surrounding the injection, can often lead to significant discomfort for a child. In contrast, the application of topical anesthesia is a reassuring process that can minimize stress in this setting. As such, the use of topical anesthesia is encouraged as a first-line option when performing minimally invasive office-based procedures on children. In cases where topical agents alone are insufficient, the members of the work group agree that adjunctive use of topical anesthesia to lessen the discomfort of infiltrative anesthesia should be considered. When more extensive surgery is required, combination of the 2 methods may also be used in select patients to avoid the need for sedation or general anesthesia.<sup>32,33</sup> The gap in research in this important area calls for future randomized controlled trials to compare the efficacy of topical and combination of topical and infiltration anesthesia for office-based procedures in children.

### **LOCAL INFILTRATION ANESTHESIA**

The recommendations for the use of local infiltrative anesthesia and the strength of evidence are listed in [Table VI](#) and [Table VII](#), respectively.

#### **Safety and efficacy**

Local infiltrative anesthesia is commonly used for a wide variety of office-based dermatologic

**Table VI.** Recommendations for the use of local infiltrative anesthesia in dermatologic surgery

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Infiltrative anesthesia is safe and recommended for office-based dermatologic procedures, including but not limited to obtaining a biopsy specimen, excision, wound closure, tissue rearrangement, skin grafting, cauterization, nonablative laser, and ablative skin resurfacing

Infiltrative anesthesia may be combined with other forms of local anesthesia for larger or more complex cutaneous procedures, including but not limited to:

- Full-face ablative laser resurfacing, combined with topical and nerve block anesthesia
- Follicular unit hair transplantation, combined with tumescent local anesthesia

The maximum safe dose of local infiltrated anesthesia is unknown

For adults, no more than 4.5 mg/kg of lidocaine and 7.0 mg/kg of lidocaine with epinephrine should be administered in a single treatment

For children, no more than 1.5-2.0 mg/kg of lidocaine and 3.0-4.5 mg/kg of lidocaine with epinephrine should be administered in a single treatment

For a multistage procedure, such as Mohs micrographic surgery, a maximum dose of local infiltrative anesthesia of 50 mL of 1% lidocaine solution (500 mg) delivered over several hours is recommended

Use of either ester-type local anesthetics, bacteriostatic normal saline, or 1% diphenhydramine is suggested as an alternate form of local infiltration anesthesia for patients with true allergy to lidocaine

Steps recommended to decrease the risk of local anesthetic systemic toxicity:

- Use the lowest effective dose of local anesthetic
- Aspirate the needle/catheter prior to each injection to avoid introducing the drug directly into a vessel
- Use incremental injections of anesthetic
- Continually assess and communicate with the patient to monitor for signs of early toxicity

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**Table VII.** Strength of recommendations for the use of local infiltrative anesthesia in dermatologic surgery

Recommendation	Strength of recommendation	Level of evidence	References
Use of local infiltrative anesthesia for obtaining a biopsy specimen, excision, wound closure, tissue rearrangement, skin grafting, cauterization, nonablative laser, and ablative skin resurfacing	C	III	Expert opinion
Combining methods of local anesthesia for full-face ablative laser and follicular unit hair transplantation	C	III	Expert opinion
Maximum dose of 4.5 mg/kg of lidocaine and 7.0 mg/kg of lidocaine with epinephrine for adults	C	III	3,44,45
Maximum dose of 1.5-2.0 mg/kg of lidocaine and 3.0-4.5 mg/kg of lidocaine with epinephrine	C	III	3
Max dose of 500 mg of lidocaine for a multistage Mohs micrographic surgery	B	II	46
Use of ester type local anesthetics for patients with lidocaine allergy	C	III	47
Use of diphenhydramine for patients with lidocaine allergy	C	III	48,49
Use of bacteriostatic normal saline for patients with lidocaine allergy	C	III	50
Prevention of local anesthetic systemic toxicity	A	I, II	51-53

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procedures, and adverse events from medications delivered in this manner are rarely reported. There are no comparative studies to suggest that infiltrative anesthesia is safer than any other type of local anesthesia, and the work group considers topical, infiltrative, local nerve block, and tumescent local anesthesia all to be safe for use in the office-based setting. Based on clinical experience, procedures

including but not limited to skin biopsy, excision, wound closure, tissue rearrangement, skin grafting, cauterization, nonablative laser, and ablative laser resurfacing may all be successfully performed under local infiltrative anesthesia. There are also no data to suggest that infiltrative anesthesia is more effective than other forms of local anesthesia. The only comparative study found regional nerve block and

local infiltration anesthesia to have equal efficacy in ptosis surgery, according to patient satisfaction with anesthesia.<sup>54</sup> The work group also finds it safe and effective to combine methods of local anesthesia for certain dermatologic procedures in order to prolong anesthesia, increase tolerability, or to minimize adverse effects of higher quantity of one agent. Infiltrative, topical, and local nerve block anesthesia together is a helpful combination for larger or more complex cutaneous procedures, such as full-face ablative laser resurfacing or Mohs micrographic surgery (MMS). Tumescence local anesthesia and infiltrative anesthesia are also useful in adjunct when preparing the recipient site for follicular unit hair transplantation.

Allergy to lidocaine is rare, with a genuine immunologic reaction representing only 1% of all adverse reactions to these medications.<sup>47,55,56</sup> For patients with a true allergy to lidocaine, one option is to switch to an ester type of local anesthetic, given that cross-reaction between both types is rare and usually attributed to paraben allergy in preservative-containing amide preparations or cosensitization.<sup>47</sup> Injection of 1% diphenhydramine has been also suggested, although it has a longer onset of action (5 min vs. 1 min for lidocaine) and limited efficacy.<sup>48,49</sup> Bacteriostatic saline (0.9% benzyl alcohol in normal saline) is another alternative, and 1 study suggests that injection of this agent with epinephrine may be less painful than injection of diphenhydramine.<sup>50</sup> Based on experience of the work group, injection of diphenhydramine or bacteriostatic normal saline may be useful as an anesthetic for small excisions and biopsies in patients with sensitivity or allergy to lidocaine.

### Dosing

The maximum safe dose of local infiltrative anesthesia is unknown. Manufacturer recommended maximum doses of 7 mg/kg of lidocaine with epinephrine and 4.5 mg/kg of lidocaine without epinephrine appear safe for local infiltration in adults. Doses of 3.0 to 4.5 mg/kg of lidocaine with epinephrine and 1.5 to 2.0 mg/kg of lidocaine without epinephrine appear to be safe in children.<sup>3</sup> Expert opinion and clinical experience support the safety of these doses, but no published evidence exists to support these maximum limits.<sup>44,45</sup> Tumescence local anesthesia is a specialized form of local anesthesia, and its uses and safety are addressed later in this Guideline. A total lidocaine dose of 55 mg/kg has been found to be safe for office-based liposuction using tumescence local anesthesia.

There are also no studies examining the impact that incremental dosing over an extended time

period has on the maximum safe amount of infiltrative anesthesia. A single prospective cohort study found a total dose of 50 mL of 1% lidocaine (500 mg) delivered in multiple increments over an average of 8 hours to be safe in MMS.<sup>46</sup> No signs of toxicity were observed, and serum lidocaine values did not approach toxic levels. Further investigation into the safety of local infiltration anesthesia when delivered incrementally over time may be helpful for planning lengthy or extensive office-based procedures.

### Toxicity monitoring and prevention

Although there is great interpatient variability in the manifestations of LAST, the signs and symptoms tend to follow a progression of central nervous system excitement. The patient may initially experience circumoral numbness, facial tingling, pressured or slurred speech, metallic taste, auditory changes, and hallucinations, which may also be accompanied by hypertension and tachycardia. As the condition evolves, seizures or central nervous system depression may develop, and severe cases may end in cardiac failure or arrest.<sup>51</sup> The dose of local anesthesia needed for most dermatologic procedures is well below the manufacturer-recommended maximum, and anesthetic toxicity in the dermatologic setting is extremely rare. In addition, a new, easy-to-remember formula to calculate the maximum allowable volume of 2 of the most common local anesthetic agents used in dermatologic procedures may prevent any incidence of toxicity caused by errors in calculation.<sup>57</sup> As such, the treatment of LAST is beyond the scope of this guideline, although additional guidance can be sought in the literature.<sup>52</sup> Clinicians should be mindful of the potential for toxicity, however, and take the steps listed in [Table VI](#) to ensure patient safety.<sup>51-53</sup> Use of ultrasonographic guidance and intravascular markers have been suggested as additional precautions in order to avoid introducing the drug directly into a vessel.<sup>51-53</sup> This work group agrees that these methods may be considered but are not practical for everyday use by most dermatologists.

### Addition of epinephrine

The recommendations for mixing and the use of additives to local infiltration anesthesia and the strength of evidence are listed in [Tables VIII](#) and [IX](#), respectively.

Vasoconstrictors play an important role in providing optimal local anesthesia in dermatologic surgery by slowing mobilization of the anesthetic and thereby prolonging its effect, reducing peak blood levels, and providing hemostasis. Epinephrine (adrenaline) is the most common vasoconstrictor



**Table VIII.** Recommendations for mixing and the use of additives to local infiltrative anesthesia in dermatologic surgery**Epinephrine**

The addition of epinephrine to local infiltration anesthesia is safe and recommended for use on the ear, nose, hand, feet, and digits

The addition of epinephrine to local infiltration anesthesia may be considered for use during procedures on the penis

Local infiltrative anesthesia with epinephrine may be used in small amounts in women who are pregnant:

Elective procedures and those not of urgent medical necessity requiring lidocaine with epinephrine should be postponed until after delivery

Procedures of urgent medical necessity should be delayed until the second trimester when possible

In case of doubt, consult with the patient's obstetrician

Local infiltrative anesthesia with epinephrine may be administered to patients with stable cardiac disease. If uncertain of a patient's ability to tolerate epinephrine, consult with the patient's cardiologist

Use of the lowest effective concentration of epinephrine to provide pain control and vasoconstriction in local infiltrative anesthesia is recommended

**Hyaluronidase**

Hyaluronidase may be used as an additive to local infiltration anesthesia to ease diffusion and reduce contour distortion, yet there are insufficient data to support a recommendation for its routine use in dermatologic surgery

Hyaluronidase should not be administered to patients with a known bee venom allergy

**Buffering**

The addition of sodium bicarbonate to local anesthetic, particularly lidocaine with epinephrine, is recommended to decrease the pain of delivery by subcutaneous or intradermal infiltration

Preinjection of buffered lidocaine solution is suggested to reduce the pain of bupivacaine infiltration

**Mixing local anesthetics**

It is unclear whether mixing multiple anesthetics for local infiltration poses further benefit over use of a single agent

**Table IX.** Strength of recommendations for mixing and the use of additives to local infiltrative anesthesia in dermatologic surgery

Recommendation	Strength of recommendation	Level of evidence	References
Addition of epinephrine to local anesthesia on the ear, nose, and digits	A	I, II	58-68
Addition of epinephrine to local anesthesia on the penis	B	II	69
Addition of epinephrine to local anesthesia in women who are pregnant or nursing	B	II	22
Addition of epinephrine to local anesthesia in patients with stable cardiac disease	B	I, II	70,71
Addition of epinephrine to local infiltrative anesthesia at the lowest effective concentration	B	II, III	72-74
Against addition of hyaluronidase to local anesthesia in patients with bee venom allergy	B	II	75
Against use of hyaluronidase to reduce tissue distortion and improve undermining	C	III	76,77
Addition of sodium bicarbonate to reduce pain of local anesthetic infiltration	A	I, II	78-82
Preinjection of buffered lidocaine to reduce pain of bupivacaine injection	C	III	Expert opinion
Mixing multiple anesthetics for the same procedure	C	II	83-90

used in local anesthetics. Clinicians historically maintained the idea that using vasoconstrictors in areas of skin served by terminal vessels would lead to necrosis. Extensive research has since examined this

issue, and there is sufficient evidence to refute this dogma. Multiple systematic reviews and randomized controlled trials have found the addition of epinephrine to local infiltrative anesthesia to be safe for use in

the digits, hands, and feet.<sup>58-67</sup> No cases of necrosis were reported, and the use of epinephrine resulted in less need for tourniquet plus faster onset and longer duration of anesthesia.<sup>61,66,67</sup> The addition of epinephrine to tumescent local anesthesia for ear and nose reconstruction also resulted in no anesthesia-related complications, and led to decreased operative time and need for electrocautery hemostasis.<sup>68</sup> Unlike other factors, such as excessive injection volume, burn from hot soaks, or excessive tourniquet pressure,<sup>59</sup> epinephrine affords many benefits without the risk of skin necrosis. As such, the authors recommend adding epinephrine to local anesthesia when cutaneous surgery is to be performed at these anatomic locations.

A single retrospective study examined the addition of epinephrine to anesthesia for local penile ring block during circumcision. Investigators did not observe any anesthetic-related complications.<sup>69</sup> Clinical experience of the panel has also been that epinephrine is safe for use in penile skin surgery. Studies are limited, and additional data would be helpful in strengthening this recommendation.

Epinephrine is rated as a pregnancy category C drug by the US Food and Drug Administration, but in small amounts appears safe for use with local infiltrative anesthesia in pregnant women.<sup>22</sup> One study suggested an increase in malformations when mothers were exposed to systemic epinephrine in the first trimester.<sup>22</sup> The alfa-adrenergic properties of epinephrine may cause vasoconstriction of placental blood vessels. When used in small amounts for dermatologic surgery, however, the local vasoconstriction afforded by epinephrine limits maternal blood level and placental transfer of lidocaine, and the benefits seem to outweigh the risks.<sup>22</sup> Despite this, clinicians should postpone nonemergent dermatologic surgery requiring local infiltration anesthesia until after delivery to avoid undue risk. If possible, urgent surgery should be delayed until at least the second trimester. In cases where large amounts of anesthesia are necessary, consultation with the patient's obstetrician may be helpful to assess the risk to benefit ratio of the procedure.

The safety of small amounts of local infiltrative anesthesia with epinephrine in patients with stable cardiac disease has been demonstrated in dental surgery.<sup>70</sup> Patients with stable, controlled cardiovascular conditions, including hypertension, ischemic heart disease, arrhythmia, chronic coronary disease, and heart transplantation, were able to tolerate intraoral infiltration of a variety of anesthetics (eg, lidocaine 2%, mepivacaine 2%, and prilocaine 2%) combined with epinephrine (ranging from 1:80,000

to 1:200,000) and felypressin at doses between 1.8 and 3.6 mL.<sup>70,71</sup> Similar studies have not been conducted in the dermatologic setting, where procedures may require between 1 and 50 mL of anesthetic solution. In the clinical experience of the panel, however, local infiltration anesthesia with epinephrine has been used safely for dermatologic procedures in patients with stable cardiovascular disease. Combining clinical experience with the data extrapolated from the dental literature, the work group recommends that epinephrine in small amounts is safe for dermatologic surgery in this population. If a patient's ability to safely undergo a procedure is in question because of cardiovascular disease, consultation with the patient's cardiologist is recommended.

The most commonly used concentrations of epinephrine in dermatologic surgery are 1:100,000 and 1:200,000. Addition of epinephrine in concentrations of 1:50,000, 1:100,000, and 1:200,000 were all shown to have the same effects on vasoconstriction, and may prolong the anesthetic duration of lidocaine and bupivacaine by approximately 200%.<sup>72-74</sup> Concentrations of 1:800,000 to 1:3,200,000 prolong the duration of anesthesia by approximately 100%, and, while data are conflicting, may offer less effective vasoconstriction than the aforementioned concentrations.<sup>72,74</sup> Although complications from epinephrine added to local anesthesia at these doses are rare, the clinical experience of the work group suggests that sensitivity to the drug varies, and symptoms of palpitations and anxiety may occur in some patients. The authors recommend using the lowest effective concentration of epinephrine for dermatologic procedures.<sup>73,74</sup>

### Addition of hyaluronidase

Hyaluronidase may be added to infiltration anesthesia with the intent of enhancing diffusion of the anesthetic solution. The mixing of hyaluronidase and infiltrative anesthesia is safe as demonstrated by 1 controlled trial, and aside from hypersensitivity reactions, adverse events caused by the agent have not been cited.<sup>75,91,92</sup> Cross-reactivity between bee venom and hyaluronidase exists, and hyaluronidase should not be administered to patients with a history of bee sting allergy. When allergy to hyaluronidase is in question, prick testing may be used for confirmation.<sup>75</sup>

While used more commonly in other medical specialties, the benefits of hyaluronidase in dermatologic procedures remain unclear. Reports describing experience with mixing 7.2 IU of hyaluronidase with local anesthetic for various skin surgeries claim the drug helps minimize tissue

distortion during infiltration and enhances ease of tissue undermining while operating.<sup>76,77</sup> However, there are no data to support these assertions. Randomized trials evaluating the effects of adding hyaluronidase to local infiltration anesthesia are needed to support these observations, and no recommendations for or against its use in dermatologic surgery can be made at this time.

### **Addition of sodium bicarbonate**

There are multiple well-designed randomized controlled trials showing that the addition of sodium bicarbonate to local anesthetic in order to raise the pH (known as buffering) decreases patient pain during drug delivery via subcutaneous or intradermal infiltration.<sup>78-81</sup> In these studies, approximately 2 out of 3 patients noted a 20% to 40% decrease in injection pain with the addition of sodium bicarbonate compared to plain lidocaine with epinephrine. Other confirmatory studies that did not find statistical significance were likely underpowered.<sup>82</sup> One non-confirmatory study compared a solution of 0.1% lidocaine without bicarbonate to a solution of 1% lidocaine with bicarbonate.<sup>93</sup> This was not a relevant comparison, however, because there was a 10-fold difference in lidocaine concentrations between the 2 groups. While the addition of sodium bicarbonate to infiltration anesthesia has not been examined in the pediatric population, the authors find that buffering anesthetic also decreases injection pain in children.

Lidocaine and bupivacaine were the only drugs studied, and the work group does not recommend buffering of the latter, because precipitation of the anesthetic may lead to decreased efficacy. The concentrations of sodium bicarbonate varied from 10 to 100 mEq/L. Most solutions were prepared by mixing 8.4% sodium bicarbonate and 1% lidocaine with epinephrine in a 1:9 or 1:10 ratio by volume, and members of the work group find both proportions to be effective in practice. Uncertainty is held by many clinicians regarding the duration of time that such a solution will remain active once buffered, because a rise in pH will cause precipitation of epinephrine and decrease the potential for vasoconstriction. Investigators found the concentration of epinephrine to decrease by 25% per week after the addition of 100 mEq/L of sodium bicarbonate.<sup>80</sup> A follow-up study confirmed that buffered anesthetic solutions prepared 1 week before use caused nearly equal areas of anesthesia and vasoconstriction as solutions mixed the day of the procedure.<sup>79</sup> This evidence suggests that buffered solutions of 1% lidocaine with epinephrine may be prepared up to 1 week in advance of use.

### **Mixing local infiltration anesthetics**

Mixing 2 (and sometimes more) local anesthetics to obtain an earlier onset and longer duration is not an uncommon practice, and multiple randomized controlled trials comparing mixtures of local anesthetics have been conducted in both the ophthalmologic and dermatologic settings.<sup>83-90,94-96</sup> The combinations studied include bupivacaine and lidocaine, bupivacaine and mepivacaine, and prilocaine and ropivacaine. The clinical methodologies used and the conclusions drawn vary, but evidence suggests that mixing these agents for local infiltration and nerve block anesthesia is safe and effective. There are insufficient data to determine whether any combination results in a faster onset or longer duration of anesthesia, and no strong evidence supports the benefits of mixing anesthetics over the use of a single agent. The decision of when and how to use a mixture of drugs therefore currently rests on the experience and comfort level of the clinician. Additional research into the utility of mixing local anesthetics is warranted.

### **Minimizing pain of administration**

The recommendations for minimizing pain of administration of infiltrative anesthesia (besides adding bicarbonate) and alternate methods of analgesia and the strength of evidence are listed in [Tables X](#) and [XI](#), respectively.

There are separate, single, randomized control trials with small sample sizes that support the efficacy of slow infiltration rate, vibrating the skin, use of a warm (40°C) solution, and cold air skin cooling to decrease the pain of local anesthetic injection in adults.<sup>97-101</sup> Expert clinical experience supports the data from these studies, and also finds these measures to be of comparable benefit for use in children. Additional confirmatory studies on the utility of these techniques are needed.

Of studies conducted to evaluate the difference in pain upon intradermal and subcutaneous infiltration of different local anesthetics, only 1 incorporated a sufficiently large sample size. The roster of compared anesthetics differed amongst the trials, as did the findings of which medication hurt least upon injection. Two smaller trials found etidocaine to elicit the most discomfort and lidocaine the least of the studied drugs.<sup>112,113</sup> A third much larger trial found a preparation of mepivacaine from 1 manufacturer to cause less pain than lidocaine, while a preparation of mepivacaine from a second manufacturer induced more pain.<sup>114</sup> Additional study would be helpful to ascertain the reasons behind the differences in these findings and to aid in formulating a concrete recommendation.

**Table X.** Recommendations for minimizing pain of administration of local infiltration anesthesia and alternate methods of analgesia in dermatologic surgery

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Slow rate of infiltration, vibration of the skin, use of a warm solution, or cold air skin cooling should be considered to decrease the pain of local anesthetic injection
It is unclear whether pretreatment with ethyl chloride spray, preinjection with normal saline, or verbal distraction decreases the pain of local anesthetic infiltration
There is contradictory evidence regarding the effectiveness of ethyl chloride, and its use as a sole method for analgesia in dermatologic procedures should not be considered
Cold air skin cooling may be considered to reduce patient discomfort during nonablative laser therapy
Use of a skin-vibrating device may be considered to help decrease the pain of botulinum toxin injection

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**Table XI.** Strength of recommendations for minimizing pain of administration of local infiltration anesthesia and alternate methods of analgesia in dermatologic surgery

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Recommendation	Strength of recommendation	Level of evidence	References
Slow rate of infiltration, vibration of the skin, use of a warm solution, and cold air skin cooling are recommended to decrease the pain of local anesthetic injection	B	II	97-101
Pretreatment with ethyl chloride spray, preinjection with normal saline, or verbal distraction to decrease the pain of local anesthetic infiltration	C	III	Expert opinion, 102
Ethyl chloride as an analgesic for dermatologic procedures	C	III	103-108
Cold air skin cooling to reduce patient discomfort during nonablative laser therapy	B	II	109,110
Use of a skin-vibrating device to decrease the pain of botulinum toxin injection into glabellar rhytides	B	II	111

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There are limited and contradictory data examining the use of ethyl chloride, ice, verbal distraction, or preinjection of normal saline to decrease the pain of administering local anesthesia. While experience with these modalities has been that they are safe to use, and it has been suggested that combination of some of these techniques may increase patient acceptance of pain,<sup>102</sup> there does not appear to be clinical consensus or widespread agreement as to the true effectiveness of these methods.

#### ALTERNATE METHODS OF ANALGESIA

In addition to anesthetic drugs, multiple other modalities are available to alleviate patient discomfort during dermatologic procedures. There is, however, a great deal of variability in the level of evidence to support these methods. There is contradictory evidence regarding the pain reduction potential of ethyl chloride, with some studies showing benefit, some finding no benefit, and 1 showing that no anesthetic was superior.<sup>103-107</sup> Many of these studies were not blinded because of infeasibility, and the interventions evaluated were difficult to compare to one another. In addition, all of the investigations of ethyl chloride were conducted to assess its use in

venipuncture, venous cannulation, or skin prick testing, which are different from procedures performed by dermatologists. Because of conflicting evidence and a paucity of data, no recommendation for or against the use of ethyl chloride spray as a stand-alone method of analgesia to decrease the pain of different procedures for dermatologic surgery can be rendered. Additional high quality trials are needed. If considering ethyl chloride for analgesia before the use of energy-based devices, caution should be used because it is flammable. There is 1 reported case of unwanted ignition with laser therapy that caused a first-degree burn.<sup>108</sup>

Two prospective, nonrandomized studies support the utility of cold air skin cooling in reducing pain and discomfort associated with nonablative laser procedures on the face. The first found cold air skin cooling to be superior to ice gel analgesia, while the second concluded that pulsed-dye laser treatment was more comfortable with cold air than without, and that cooling was associated with fewer thermal side effects and only a slight decrease in clearing of facial telangiectasias.<sup>109,110</sup> Other studies showing the limitations of the technique found cold air to be inferior to nerve block for facial photodynamic therapy, and

**Table XII.** Recommendations for nerve blocks in dermatologic surgery

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Regional cutaneous nerve block anesthesia is recommended for ablative laser resurfacing of the face and botulinum toxin injection of the palm

Nerve block should be considered as an alternative or in addition to infiltrative anesthesia for procedures on the face, hands, feet, and digits, and may provide the benefit of decreased tissue swelling/distortion, prolong anesthesia, and reduce postoperative discomfort for the patient

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**Table XIII.** Strength of recommendations for nerve blocks in dermatologic surgery

Recommendation	Strength of recommendation	Level of evidence	References
Nerve block anesthesia for ablative laser resurfacing of the face, botulinum toxin injection of the palm, and upper lid ptosis surgery	B	II	54,118-120
Nerve block as an alternate to local infiltration anesthesia for dermatologic surgery on the face and digits	C	III	Expert opinion

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the combination of cold air and nerve block was equal to nerve block alone for ablative laser resurfacing on the face.<sup>115,116</sup> In addition to the data presented, the experience of the work group finds that despite limited utility in ablative procedures, cold air skin cooling can be efficacious for use in nonablative laser therapy and may be considered when patient comfort is of concern.

Lastly, there is also evidence to support the use of vibration to reduce pain of skin injections. One randomized, controlled, split-face trial found a significant decrease in pain of botulinum toxin injection to glabellar rhytides with the use of a skin vibration device.<sup>111</sup> Vibration has also been shown to be effective for reducing pain of other injections, including those of local anesthetic in eyelid surgery and venipuncture in the pediatric emergency room.<sup>101,117</sup> It may be helpful to consider use of vibration for injections performed in the dermatologic setting, especially for children and anxious adults.

### Nerve blocks

The recommendations for nerve blocks and the strength of evidence are listed in [Tables XII](#) and [XIII](#), respectively.

A majority of investigations into the utility of nerve block anesthesia have been conducted outside the realm of dermatology, with dental studies dominating. Research for use in dermatologic procedures has found the technique to be safe when performed in this setting. Neither nerve damage nor other major adverse events have been reported, and mild events were limited to hematoma formation and 1 case of

pain at the site of ulnar nerve block, all of which were transient.<sup>54,115,118-125</sup>

A review of the literature finds a modicum of evidence demonstrating the effectiveness of nerve block anesthesia for specific indications compared to other forms of local anesthesia. One dermatologic study found nerve block to be superior to topical anesthesia for patient-perceived pain while undergoing laser surgery on the face.<sup>120</sup> Multiple investigators have noted the efficacy of wrist nerve block before botulinum toxin injection for palmar hyperhidrosis, with 1 finding it superior to skin cooling.<sup>118,119</sup> An additional study comparing nerve block to local infiltrative anesthesia for ptosis surgery showed an equal level of patient satisfaction with the 2 techniques, supporting the potential use of nerve blocks as a valid alternative for this procedure.<sup>54</sup> Lastly, regional nerve blocks have also been shown to effectively reduce pain in full-face photodynamic therapy for actinic keratosis, with 1 study finding the technique superior to skin cooling.<sup>115,123,124</sup>

Clinical experience has shown nerve block anesthesia to be effective in situations beyond those described in the literature. A digital block may induce less injection pain than local infiltration of the tip of a finger or toe, and may also achieve a longer duration of anesthesia, resulting in less postoperative discomfort for the patient. In other areas, such as the lip and eyelid, nerve blocks allow for surgery without the local tissue swelling and distortion inherent with local infiltrative anesthesia. This can facilitate more precise surgery, albeit with the loss of benefit provided from epinephrine as a vasoconstrictor when used locally. There is a gap



**Table XIV.** Recommendations for tumescent local anesthesia in dermatologic surgery

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Lidocaine and prilocaine are both safe and recommended for use in tumescent local anesthesia for office-based liposuction.  
 Bupivacaine is not recommended for this use  
 Use of prilocaine is not approved in the United States for this procedure as of the date of this publication.  
 The addition of epinephrine to lidocaine is recommended and safe for use in tumescent local anesthesia for liposuction  
 A maximum dose of 55 mg/kg of lidocaine with epinephrine has been shown to be safe and can be used for tumescent local anesthesia for liposuction in patients weighing 43.6-81.8 kg  
 The use of warm anesthetic solution and a slow infiltration rate is recommended to decrease patient discomfort during administration of tumescent local anesthesia

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**Table XV.** Strength of recommendations for tumescent local anesthesia in dermatologic surgery

Recommendation	Strength of recommendation	Level of evidence	References
Lidocaine and prilocaine for use in tumescent local anesthesia for office-based liposuction	A	I, II	126-134
The addition of epinephrine to lidocaine for use in tumescent local anesthesia for liposuction	A	I, II	126-131
A maximum dose of 55 mg/kg of lidocaine with epinephrine for local tumescent anesthesia for liposuction	A	I	135
Use of a warm solution to decrease patient discomfort during administration of tumescent local anesthesia	B	II	98
Use of a slow infiltration rate to decrease patient discomfort during administration of tumescent local anesthesia	C	III	136

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in research in these areas, however. To better define the role of the technique in dermatologic surgery, studies comparing nerve block and infiltrative anesthesia for procedures on the nose, cheeks, lips, eyelids, hands, feet, digits, and nails would be helpful.

### Tumescent local anesthesia

The recommendations for tumescent local anesthesia and the strength of evidence are listed in [Tables XIV](#) and [XV](#), respectively.

Tumescent local anesthesia, which was developed by a dermatologist, uses the subcutaneous infiltration of large volumes of dilute anesthetic to produce swelling and firmness of the targeted areas.<sup>126</sup> There is substantial evidence to support the safety of tumescent local anesthesia when used for office-based liposuction. There are no reports of death associated with liposuction performed under tumescent local anesthesia by dermatologists, and multiple studies estimate the rate of serious adverse events to be 0.04% to 0.16%.<sup>137-141</sup> Lidocaine with epinephrine is the most commonly studied solution and has been shown to be effective at multiple concentrations.<sup>126-131</sup> A well conducted prospective study found local tumescent anesthesia with lidocaine doses of 55 mg/kg to be safe for use in office-

based liposuction, and expert experience supports this finding.<sup>135</sup> This recommendation is valid only for the weight range studied (43.6-81.8 kg), and the safety of this dose on patients weighing outside this range has not been confirmed. Prilocaine is not approved in the United States for tumescent local anesthesia, but it is also safe and effective for this procedure.<sup>132-134</sup> A combination of lidocaine and prilocaine may reduce the risk of toxicity from either drug and might be favorable in cases where a large volume of tumescent local anesthesia is needed.<sup>132</sup> There are no data examining other anesthetics for use in tumescent local anesthesia, including bupivacaine, and therefore no recommendations can be rendered.

As discussed above (see local infiltration anesthesia, minimizing the pain of administration), the use of a warm (40°C) solution is associated with significantly less patient discomfort during anesthetic infiltration in tumescent local anesthesia.<sup>98</sup> A single retrospective study of data from 4 experienced surgeons suggests that a slower rate of infusion also causes less patient discomfort during anesthetic administration but has no effect on pain level during liposuction.<sup>136</sup> Additional trials with confirmatory data would help to strengthen the level of these recommendations.

## GAPS IN RESEARCH

The most current and highest level of evidence was examined in order to create this guideline. This thorough appraisal of the literature has revealed several areas in which additional investigation is needed regarding the use of local anesthesia for dermatologic procedures. Although mention is made in the narrative above, the work group would like to place additional emphasis on gaps in research, which include but are not limited to: randomized controlled trials to compare topical anesthetic to infiltrative local anesthetic for minor dermatologic procedures in children and adults; studies examining the effect of occlusion and type of vehicle (ie, cream, gel, and ointment) on the safety and efficacy of topical anesthetics; randomized controlled trials to compare the pain of administration and anesthetic efficacy of infiltrative anesthesia versus regional nerve block for dermatologic surgery on the face, hands, feet, and digits; additional data on the maximum safe dosage of local infiltration anesthesia for large, multistage procedures, such as Mohs micrographic surgery; additional trials on effectiveness of techniques used to decrease the pain of administering infiltrative anesthesia, including methods of auditory and visual distraction in children; well-designed studies to determine the utility of combining different infiltrative anesthetics for the same procedure; randomized controlled trials to examine the benefits of adding hyaluronidase to local infiltrative anesthesia; and randomized controlled trials to examine the effect rate of infiltration has on patient discomfort during tumescent local anesthesia for liposuction. It is hoped that such gaps are closed to further optimize the use of local anesthesia for office-based dermatologic surgery.

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The below information represents the authors disclosed relationships with industry. Relevant relationships requiring recusal for drafting of guideline recommendations and content were not noted for this guideline.

Murad Alam, MD, served as consultant for Amway Corporation, receiving honoraria, and as Principal

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Bernard Cohen, MD, served on the Advisory Board of Sanofi-Aventis, receiving honoraria.

C. William Hanke, MD, received honoraria serving on the Advisory Board of Allergan, Inc, as consultant for Orlando Dermatology Aesthetic & Clinical, as speaker for LEO Pharma and Genentech, Inc, and in other roles for Educational Testing and Assessment Systems, Inc and for Sanova Works. In addition, Dr Hanke served as PI in grants funded by Allergan, Inc, Derm Advance, Genentech, Inc, and LEO Pharma, and received compensation for patent royalties or other compensation for intellectual property rights from Elsevier, Informa HealthCare, and Springer Science & Business Media.

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