# Applied Anesthesia

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Thomas J. Joly

Attended local anesthesia is the preferred method in most cases of oculoplastic surgery in adults. Procedures are relatively brief and can be performed with minimal hazard to the patient's general health. Topical anesthesia of the eye can be used for excision of minor conjunctival lesions or, in combination with local infiltrative anesthesia, to prevent irritation to the eye during preparation for surgery. Topical anesthesia of the skin can be used for simple lesion excisions from the eyelid or to avoid the pain of local infiltrative anesthesia or cosmetic filler injection.

## Anesthetic Agents

### Topical Anesthetics

The most widely used agents in topical anesthesia are proparacaine and tetracaine. Proparacaine is less irritating than tetracaine, but it has poor corneal penetration and a shorter duration of action. It is available as a 0.5% solution, and its anesthetic effect lasts 5–15 min after application.

Tetracaine, although more irritating than proparacaine, gives more prolonged anesthesia because of its better corneal penetration. It is available as a 0.5% solution in both preserved and preservative-free preparations.

Topical anesthesia of the eyelid skin requires lipophilic agents that will penetrate its keratinized epithelium. Agents with higher concentrations of anesthetic, lower melting points, and the addition of solvents or surfactants that increase skin permeability will achieve more effective anesthesia. Fortuitously, the thinness of eyelid skin facilitates more effective permeability [1].

Eutectic mixture of local anesthetics (EMLA) is a combination of 2.5% lidocaine and 2.5% prilocaine in an oil/water emulsion resulting in a lower melting point than either agent alone, thus facilitating skin penetration. Applied in a thick layer under an occlusive dressing, its anesthetic effect increases with application time. Adequate effectiveness can be achieved with as little as 20–30 min application, but 60 min or more is needed for optimal effect.

Liposomal lidocaine 4% or 5% (ELA-Max) uses a liposome matrix to enhance skin penetration of lidocaine. It is applied for 15–40 min and may provide longer-lasting anesthesia than non-liposomal preparations. Microemulsion lidocaine 4% or 5% (Topicaine) uses an emulsion gel delivery system and is applied for 30–60 min.

Higher anesthetic agent concentration can be achieved in formulations not available commercially but which can be provided by a compounding pharmacy. A three-agent combination—benzocaine 20%, lidocaine 6%, and tetracaine 6% ointment—is a potent and quick-acting topical anesthetic agent for eyelid and facial skin anesthesia.

### Local (Infiltration) Anesthetics

The most commonly used infiltration anesthetics are lidocaine (Xylocaine), procaine (Novocain), mepivacaine (Carbocaine), and bupivacaine (Marcaine). Hypersensitivity to procaine, tetracaine, and other ester-type anesthetics is fairly common. In contrast, lidocaine, mepivacaine, and bupivacaine are all amide-type anesthetics, to which hypersensitivity reactions are rare. Lidocaine has rapid penetration and an anesthetic effect that lasts 30–60 min. The maximum injectable dose in adults is 300 mg; however, if epinephrine is added to the solution, the maximum dose may be increased to 500 mg. The toxicity and side effects of lidocaine are more severe than those of other agents. Lidocaine is primarily used as 1–2% solutions.

A procaine injection takes effect in about 3 min, and anesthesia lasts up to an hour. The maximum injected dose in adults is 1000 mg. Procaine is primarily used as 1–2% solutions.

T. J. Joly
Department of Ophthalmology, Eastern Virginia Medical School, Norfolk, VA, USA
e-mail: tjoly@vec2020.com



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The addition of epinephrine (1:100,000; 1:200,000) to either lidocaine or procaine lengthens the duration of anesthesia and helps control bleeding.

Mepivacaine resembles lidocaine, but its action is more rapid in onset and somewhat more prolonged than that of lidocaine. It is available in 1–3% solutions. Bupivacaine is a long-acting anesthetic agent, lasting 5–25 h. It has low toxicity and is used in 0.25–0.75% solutions. A mixture of bupivacaine 0.5% and lidocaine 1% with epinephrine 1:100,000 produces rapid anesthetic effect, good hemostasis, and long postoperative analgesia.

In making the decision for local anesthesia, the metabolic state of the local tissue must be considered. Local anesthetics exist in an ionized, protonated form and a nonionized, unprotonated form depending on pH. It is in the unprotonated form that the anesthetic can penetrate the nerve cell membrane and exert its effect. Therefore, in inflamed tissue with a decreased pH, local anesthetic may be less effective; more anesthetic might be needed, or the surgeon might better resort to a regional nerve block.

## Local Infiltration

Local infiltration can be used for small lid lesions, such as papillomata, verrucae, chalazia, and xanthelasmata. The solution is injected subcutaneously before excision of lesions or subconjunctivally before excision of conjunctival lesions.

For removal of lid margin lesions and lesions requiring a full-thickness block resection of the lid (upper or lower), the following technique may be used:

### Step 1

A few drops of topical anesthetic are applied to the eye, and the eyelid is everted.

### Step 2

A fine-gauge (25, 27, or 30) needle is inserted through the conjunctiva at the upper (or lower, in a lower lid procedure) tarsal border. Approximately 0.5 mL of anesthetic solution is injected (Fig. 2.1).

### Step 3

With the needle in the same position as in Step 2, the lid is turned to its natural position, and the needle is advanced anteriorly and nasally to the subcutaneous space between the orbicularis and the orbital septum, where another 1 mL of solution is injected (Fig. 2.2).

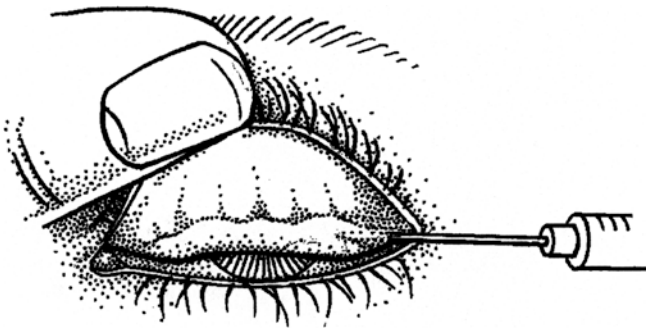

**Fig. 2.1** Local infiltration of anesthetic: step 2

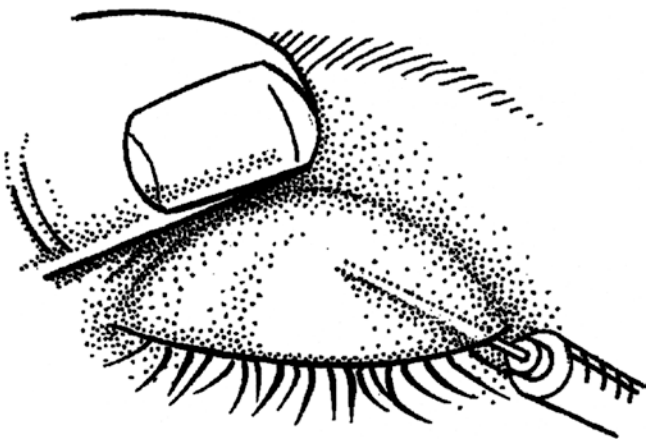

**Fig. 2.2** Local infiltration of anesthetic: step 3

## Regional Anesthesia

Nerve block anesthesia is useful (1) in cases in which large areas of lid and adnexal tissue are involved, (2) in cases of infected tissues, (3) in high-risk patients, or (4) to prevent distortion of tissue that can be caused by local infiltration. To achieve proper regional anesthesia, the surgeon must keep in mind that the sensory innervation of the face is supplied by the ophthalmic division and maxillary division of the trigeminal nerve. Blockage of its divisions (frontal, lacrimal, nasociliary, infraorbital, and zygomaticofacial) creates proper regional anesthesia for most oculoplastic surgical procedures [2].

### Lacrimal Nerve Block

The lacrimal nerve is the temporal branch of the ophthalmic division of the fifth cranial nerve. It supplies the lateral third of the upper lid and the lacrimal gland (Figs. 2.3 and 2.4). Block of this nerve is used in case of lesions of the temporal third of the upper lid and for lesions (cysts) of the lacrimal gland.

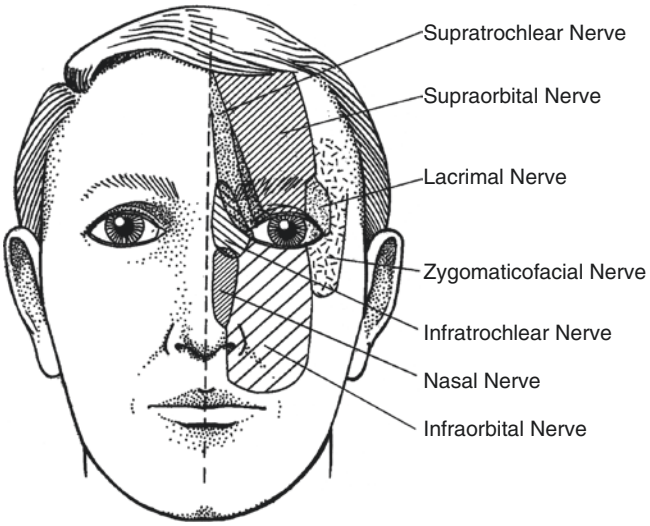


**Fig. 2.3** Facial nerve block regions

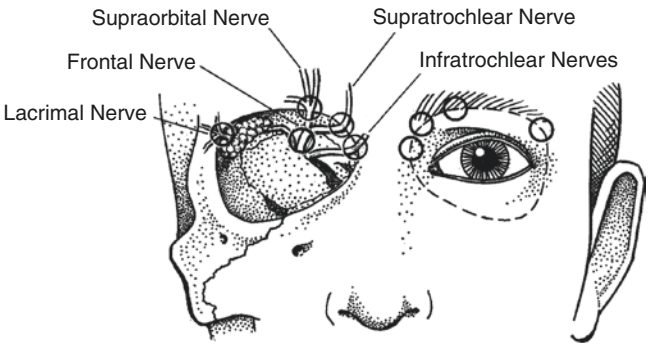


**Fig. 2.4** Nerve block sites

### Step 1

With the upper lid closed, the needle is inserted along the superolateral orbital rim and advanced posteriorly. Adequate nerve block usually requires injection behind the lacrimal gland; however, care should be taken as the lacrimal artery may be hit, with consequential bleeding.

## Frontal Nerve Block

The frontal nerve is the middle branch of the ophthalmic division. It supplies the central and nasal portion of the upper lid, through its supraorbital and supratrochlear nerves (see Figs. 2.3 and 2.4).

The supraorbital nerve emerges at the supraorbital notch, at the medial third of the superior orbital rim. It supplies the center of the upper lid, conjunctiva, eyebrow, forehead, and scalp.

### Step 1

The supraorbital notch is palpated up to the periosteum.

### Step 2

The needle is inserted temporal to this area, going back 5–10 mm, and 1 mL of solution is injected (see Figs. 2.3 and 2.4).

The supratrochlear branch of the frontal nerve exits above the trochlea, supplying the nasal part of the upper lid and eyebrow.

### Step 1

The needle is inserted a distance of 5–10 mm under the orbital rim at the junction of the roof and medial orbital wall.

### Step 2

An injection of 1 mL of anesthetic solution is given (see Figs. 2.3 and 2.4).

A full frontal nerve block including both the supraorbital and supratrochlear branches may also be achieved by inserting the needle 20 mm under the center of the upper orbital rim, along the orbital roof. This, in combination with a lacrimal nerve block, anesthetizes the entire upper lid. This procedure is useful in surgery of the upper lid. In ptosis surgery, care must be taken as a motor block of the levator palpebrae may also be induced.

## Nasociliary/Infratrochlear Nerve Block

The nasociliary nerve is the medial branch of the ophthalmic division. It supplies the inner canthus, lacrimal sac, skin, and mucosa of the nose through its anterior and posterior ethmoidal and infratrochlear branches (see Fig. 2.3).

### Step 1

The needle is inserted under the trochlea or just above the medial canthal tendon, approximately 10 mm deep (posterior), and 1 mL of solution is injected for an infratrochlear block (see Figs. 2.3 and 2.4).

### Step 2

The needle is advanced 20 mm farther to block the posterior ethmoidal nerve for a more extensive nasociliary nerve block. This step is useful when a dacryocystorhinostomy is performed under local anesthesia. Care must be taken as the anterior and posterior ethmoidal vessels may bleed profusely.

## Infraorbital Nerve Block

The infraorbital nerve is a branch of the maxillary division. It supplies the lower lid and conjunctiva and contributes innervation to the medial canthus and lacrimal sac area (Figs. 2.3 and 2.5).

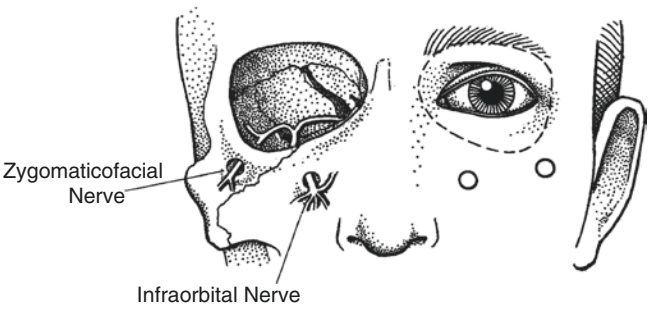


**Fig. 2.5** Infraorbital and zygomaticofacial nerves

### Step 1
The infraorbital foramen is palpated at the medial third of a line drawn between the ala nasi and lateral canthus.

### Step 2
An injection of 1 mL of anesthetic is administered into or around the infraorbital foramen.

### Alternative 1
The needle is inserted above the orbital rim, hugging the orbital floor and 10 mm deep; 1 mL of solution is injected (see Fig. 2.5).

### Alternative 2
An intraoral approach also can be used: The needle is inserted in the maxillary gingiva between the canine and first premolar and passed superiorly along the face of the maxilla to the infraorbital foramen.

## Zygomaticofacial Nerve Block

The zygomaticofacial nerve (a branch of the maxillary division) emerges from a foramen about 10 mm below the lateral canthus. It supplies the lateral canthal area and the outer part of the lower lid and shares innervation, in part, with the lacrimal nerve at the upper lid (see Fig. 2.3).

### Step 1
The zygomaticofacial foramen is palpated.

### Step 2
An injection of 1 mL of solution is administered over the zygomaticofacial foramen (see Fig. 2.5).

## Complications and Management

The ophthalmologist must be aware of the potential complications that may arise with the use of topical or local anesthetics. If the anesthetic solution is inadvertently injected into a vein or into the highly vascular conjunctiva, blood levels may rise rapidly and cause stimulation or depression of the central nervous and cardiovascular systems by either the epinephrine or anesthetic agent in the anesthetic solution.

Stimulation of the central nervous system can produce anxiety, tremors, and agitation that may lead to convulsions, coma, and respiratory depression. The effect of the anesthetic solution on the cardiovascular system may cause bradycardia, irregular pulse rate, hypotension, and syncope.

To minimize toxic effects, a preoperative history of allergies to medications should be obtained. The solutions should be used in the minimal effective dosage (percentage and volume). Solution should be injected as the needle is advanced through the tissue, thereby lowering the possibility of injecting the agent into a blood vessel.

The addition of epinephrine to the anesthetic solution is an effective means of controlling oozing and of lengthening anesthesia time. This mixture should be administered carefully, as it may cause local tissue ischemia and an abrupt rise in blood pressure. The maximum dose should not exceed 0.5 mg (5 mL of 1:10,000 solution).

If surgery is performed as an office procedure, resuscitation equipment must be available. In cases of convulsions, 5 –10 mg of intravenous diazepam (Valium) or a low dose of barbiturates should be administered. If asphyxia results from convulsions or respiratory depression, artificial respiration should be given. Hypotension and bradycardia are treated by placing the patient in a head-down position, increasing an intravenous infusion rate, and injecting alpha- or beta-stimulants (e.g., ephedrine 10 mg) intravenously.

## Systemic Anesthesia

Analgesia (loss of pain sensation), anxiolysis (loss of anxiety), sedation/hypnosis (loss of awareness), and amnesia (loss of memory) are four objectives of systemic anesthesia. Each goal may be fully or partially met with various systemic agents.

General anesthesia with inhalational agents and mechanical ventilation fully accomplishes all four anesthesia objectives. General anesthesia is indicated for some oculoplastic surgeries, including major orbital surgery, lacrimal surgery in which nasal bleeding is expected, and pediatric oculoplastic surgery; these cases are performed in consultation with an anesthesia specialist.

Monitored anesthesia care is indicated for many oculoplastic surgeries not requiring general anesthesia. Use of propofol, a benzodiazepine, and/or an opioid in combination with local or regional anesthesia can provide graded maintenance of each of the four systemic anesthesia objectives.

One important consideration in the application of these agents for monitored anesthesia care is their effect on the sternutatory reflex. This reflex is the production of a nonvol-

untary grimace, a head turn, or most commonly a sneeze by noxious stimulation of the intranasal mucosa or eyelid. Unexpected sudden head movement during periocular injection risks inadvertent damage to the eye. The sneeze reflex is rarely induced by anesthetic injection in the nonsedated patient. Propofol disinhibits this reflex, with sneeze rates of 30% or more. This disinhibition appears to be even more potentiated when a benzodiazepine is co-administered with propofol. Conversely, propofol-induced disinhibition is eliminated by co-administration of an opioid [3].

## Propofol

Propofol (Diprivan) is the most commonly used intravenous hypnotic agent in the current practice of monitored anesthesia care. It produces rapid anesthesia induction, with peak action within 1 min and rapid recovery of 5–10 min after a single bolus. Induction dosing is 2–2.5 mg/kg, and sedation can be maintained with infusion rates of 100–200 μ(mu)g/kg/min. Apnea, myocardial depression, and decreased vascular resistance are typical during induction, and excitatory phenomenon such as twitching or involuntary movements is not uncommon. Propofol has no analgesic properties and is typically used in conjunction with regional or local anesthetic injection. Because of its rapid clearance, it has limited utility for sustained anxiolysis.

## Benzodiazepines

Benzodiazepines are anxiolytic and amnesic at low doses and more profoundly sedative at higher doses. Agents include midazolam (Versed), diazepam (Valium), and lorazepam (Ativan). Benzodiazepines have minimal cardiovascular depressant properties and less respiratory depression than propofol. However, patients should be monitored for these effects, especially when benzodiazepines are administered intravenously. Flumazenil, a benzodiazepine antagonist, is used to reverse benzodiazepine effects. Benzodiazepines do not have analgesic properties.

Midazolam is typically the preferred intravenous agent in the setting of monitored anesthesia care for oculoplastic procedures due to its rapid onset of action (<5 min). Sedation dose is 0.025–0.1 mg/kg.

Although diazepam can be administered intravenously, it is more often used as an oral agent. Given orally, the sedation dose is 0.1–0.2 mg/kg with peak effect at 15–60 min and duration of action of 2–6 h. Lorazepam is longer-acting and, therefore, has less indication for oculoplastic procedures. The typical oral dose is 1–2 mg with peak effect at 2 h and duration of 6–24 h.

## Opioids

Opioids are primarily analgesic agents, although they can also have significant sedative effects. Sedative effects can be synergistic with benzodiazepines. Additionally, adequate pain control can certainly aid in anxiolysis. Agents commonly administered intravenously or intramuscularly for monitored anesthesia care include fentanyl (Sublimaze), meperidine (Demerol), and morphine. Opioids are respiratory depressants, and cardiovascular effects include bradycardia and decreased vascular resistance. Naloxone, an opioid antagonist, is used for reversal.

Fentanyl is the most commonly used intravenous agent in the setting of monitored anesthesia care. It is approximately 100 times more potent than morphine and has the additional advantages of rapid onset of action (within seconds) and short duration of action (less than 1 h). The typical analgesia dose is 0.7–2 μ(mu)g/kg. Morphine is typically dosed intravenously at 3–10 mg, while the preferred route for meperidine is intramuscular at a dose of 50–150 mg, although either agent can be administered by oral, intravenous, intramuscular, or subcutaneous routes.

Several opioids are available orally in combination with acetaminophen for postoperative pain control, including codeine (Tylenol #3), hydrocodone (Vicodin, Lortab), and oxycodone (Percocet, Tylox). With these agents, the opioid dose is limited by the amount of acetaminophen with which it is combined. The most common side effects are gastrointestinal, including nausea and constipation.

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