

# Anesthesia Management of Ophthalmic Surgery in Geriatric Patients

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## 1. Overview of Ophthalmic Surgery and Anesthesia

Ophthalmic surgery is currently the most common procedure among the elderly population in the United States, primarily performed in ambulatory surgical centers. The outcome of ophthalmic surgery is usually good because the eye disorders requiring surgery are generally not life threatening. In fact, cataract surgery can improve an elderly patient's vision dramatically leading to improvement in their quality of life and prevention of injury due to falls. There have been significant changes in many of the ophthalmic procedures, especially cataract and retinal procedures. Revolutionary improvements of the technology making these procedures easier and taking less time to perform have rendered them safer with fewer complications from the anesthesiology standpoint.

Ophthalmic surgery consists of cataract, glaucoma, and retinal surgery, including vitrectomy (20, 23, 25, or 27 gauge) and scleral buckle for not only retinal detachment, but also for diabetic retinopathy, epiretinal membrane and macular hole surgery, and radioactive plaque implantation for choroidal melanoma. Other procedures include strabismus repair, corneal transplantation, and plastic surgery, including blepharoplasty (ptosis repair), dacryocystorhinostomy (DCR) for obstruction of the tear ducts, orbitotomy for orbital tumor or exophthalmos secondary to hyperthyroidism, and trauma to repair a ruptured globe or orbital fracture.

In general, ophthalmic surgical procedures are considered low risk because of the low incidence of large volume blood loss (although DCR and orbitotomy can potentially lose up to several hundred milliliters of blood), and lack of major fluid shifts or prolonged duration (except for some complex procedures such as complicated corneal or combined retinal surgery and corneal transplantation, which can be last up to 4 to 5 hours). However, ophthalmic procedures are associated with unique complications, such as:

- 1) oculocardiac reflex (a trigemino-vagal reflex leading to variety of arrhythmias including cardiac arrest),
- 2) brain stem injection of local anesthetics during retrobulbar block which can cause not only respiratory failure requiring intubation, but also either profound hypotension and tachycardia or profound hypertension and tachycardia depending on whether the parasympathetic or sympathetic nerves are blocked,
- 3) loss of ocular contents due to patient movement or coughing during corneal or retina surgery,
- 4) increased intraocular pressure (IOP) and/or bleeding during extubation and emergence from anesthesia due to patient coughing and bucking,
- 5) anxiety or panic attack because of the surgical drape that covers patient's face,
- 6) postoperative impairment of vision from the eye patch or surgery itself (which raises concern for the risk of falling at home, especially if patients also have poor vision for their nonsurgical eye and live alone),
- 7) pain after enucleation and more complex procedures.

In addition, elderly patients undergoing general anesthesia face the same stress response from intubation, extubation and surgical stimulation, and the side effects of volatile and or intravenous anesthetics as any younger patient having any other surgery. More importantly, the underlying comorbidities place the geriatric patient at higher risk for anesthetic or medical complications. Their high prevalence of risk factors, such as hypertension, diabetic mellitus, renal insufficiency, chronic heart failure (CHF), and chronic obstructive lung disease (COPD) increase the incidence of perioperative myocardial ischemia to as high as 31 %. The mortality rate within 90 days of cataract surgery is 7.1 per 1,000 patients. In addition, surgical or anesthetic complications can also occur due to mishaps in the management of this high risk patient population. Poor outcomes are less likely to be accepted by patients, their family members, and health care providers because of the misperception of the "low surgical risk" of ophthalmic surgery in the general population. Anxiety is very common among elderly patients undergo ophthalmic surgery. Even in patients whose hypertension is reasonably well controlled at home, it is not uncommon that these patients become severely hypertensive on the day of surgery. Similar phenomenon can also occur in patients with diabetes, especially in insulin-dependent patients. It is a challenge for health care providers to take care of the geriatric patient undergoing ophthalmic procedure safely and efficiently for all of these reasons. It requires all medical subspecialists to understand the details of the ophthalmic

procedure, and recognize the additional burden on the patient's underlying comorbidity from the physiological changes caused by mental stress, surgery and anesthesia.

## 2. Anesthesia Management

The challenges of anesthesia management of geriatric patients undergoing ophthalmic surgery are numerous. The volume of procedures is high; the demand for high efficiency and quick turnover in the operating rooms is high; there is a variety of comorbidities in this population; there is high expectation of surgery and anesthesia outcomes. From a business standpoint, if you consider ophthalmic procedures as an "assembly line" operation, any variation along the "assembly line", including preoperative evaluation and optimization, patient arrival time on the day of surgery, anesthesia induction time and emergence time, and postoperative recovery and post anesthesia care unit (PACU) turnover, and the skill and comfort level of the anesthesia providers can become potential "bottlenecks" of the process. The best strategy to deal with the challenge is to have a realistically workable system in place in order to tightly control the variables and provide the highest possible care to our geriatric patients.

1) Preoperative evaluation. Adequate preoperative evaluation is part of the standard of care according to the American Society of Anesthesiologists (ASA). Ophthalmic surgery patients are a high-risk population due to the advanced age and associated comorbidities such as hypertension, diabetes mellitus, coronary artery disease, peripheral vascular disease, chronic obstructive pulmonary disease (COPD), renal deficiency, obesity, stroke, and chronic heart failure. A patient's primary care physician (PCP) plays an important role in the process to provide adequate information regarding comorbidities (history and physical examination, H/P), necessary laboratory tests, electrocardiogram, and more advanced testing if medically indicated. Ideally, every patient should be screened either in person or by telephone by an anesthesia provider or an advanced nurse practitioner in addition to the PCP.

The goal of the preoperative evaluation is not only to discover underlying medical conditions of the geriatric patient, but more importantly to make sure those conditions are optimized and clinically stable in order to handle the stress associated with surgery and anesthesia. It is an oversimplification to characterize all ophthalmic surgeries as low risk procedures. For example, the stress that a patient undergoes for a 10-minute cataract surgery under monitored anesthesia care (MAC) will be much less than a three to four hour combined corneal transplantation and retinal surgery under general endotracheal anesthesia. Without adequate preoperative evaluation, it is a guessing game for anesthesiologists to determine which patients will be able to tolerate the stress of surgery and anesthesia, which patients will most likely be able to go home without complications, and which patients will require hospital admission.

Most ophthalmic surgeries are performed at free-standing ambulatory surgical centers, in which invasive hemodynamic monitoring, echocardiogram capability, and cardiology consultation are not readily available. Because of these limitations, some patients will be determined not to be candidates for ambulatory surgery; they include patients with ASA physical status 4 (refer to a patient with severe systemic disease that is a constant threat to life), morbid obesity (BMI > 40), and those likely to require hospitalization postoperatively.

Although preoperative laboratory testing has not been shown to improve perioperative and postoperative outcome in cataract surgery, specific tests guided by a patient's medical problems are helpful to assess the severity of organ dysfunction and are valuable in perioperative anesthesia management.

In general, an electrocardiogram (ECG) is indicated when there is underlying cardiac disease or advanced age to identify changes, arrhythmia, and the presence of myocardial ischemia. When arrhythmias occur perioperatively, the preoperative ECG becomes an important baseline reference. Further tests include echocardiogram and exercise or pharmacological stress tests to evaluate the patient's functional capacity and the presence of ischemia. Test selection will depend on the patient's cardiac symptoms, exercise tolerance, and the type of surgery and anesthesia in accordance with the American Heart Association and American College of Cardiology (AHA/ACC) guidelines.

As many elderly patients live alone at home, their safety after surgery is a legitimate concern. The patient may have residual effects of the sedatives they received intraoperatively, increasing the risk of falls; there are additional risks if the non-surgical eye also has impaired vision. Ideally, a responsible adult is arranged preoperatively to watch and help the patient at home, at least overnight, until the patch is removed and full recovery from anesthesia is achieved.

2) Intraoperative management. The intraoperative management of ophthalmic anesthesia requires thoughtful planning, skillful technique, and patience in covering the broad spectrum of procedures, from a short 10-minute cataract surgery under MAC, to a multiple-hour complicated corneal transplantation under general anesthesia. The key strategy of intraoperative anesthetic management is summarized below:

a) Because of the natural physiological changes of age, the pharmacodynamics and pharmacokinetics of drugs in geriatric patients are dramatically different compared to their younger counterparts. In general, the required dose of drugs is smaller, the onset of action is slower, and respiratory and myocardial depression is more profound. Underlying disease might complicate these changes further. For example, in a patient with severe cardiomyopathy (ejection fraction of 20 %), the onset of drugs will be further delayed and the duration of drug

effects will be prolonged. Careful, slow titration is necessary when sedatives and/or narcotics are used in geriatric patients.

b) Fast-track anesthesia has been a safe choice for ophthalmic procedures in elderly patients. (Fast-track anesthesia refers to the art and science of swiftly moving patients out of the OR and PACU and sending them home in short periods.) Short acting drugs, such as propofol, alfentanil, remifentanil, and fentanyl, have all been used with good results. A balanced technique, with a combination of propofol and narcotics, has been shown to be highly effective in providing analgesia with a moderate level of sedation for orbital blocks. It has the advantage of quick onset, short duration, and low risk of respiratory complications.

c) Prevention of coughing and bucking is an important part of ophthalmic anesthesia management, especially during general anesthesia. Coughing can increase intraocular pressure by 40 to 60 mmHg which can lead to optic nerve ischemia, result in bleeding (especially in DCR and orbitotomy) and challenge the incisional integrity. Coughing and bucking during emergence from general anesthesia can also trigger laryngospasm and bronchospasm, especially in patients with asthma, COPD, or an acute upper respiratory tract infection. If there is no contraindication, a deep extubation should be strongly considered.

d) Prevention of nausea and vomiting is also a significant part of ophthalmic anesthesia. Ophthalmic procedures carry a very high incidence of post-operative nausea and vomiting (PONV), as high as 60 - 70% in strabismus repair. The act of vomiting can raise intraocular pressure as well. Administration of dexamethasone, ondansetron, adequate hydration, total intravenous anesthesia (TIVA) and avoidance of nitrous oxide are effective in prevention of PONV, especially if general anesthesia is required.

e) Prevention of head and body movement during retrobulbar block is essential to prevent injury to the globe and retrobulbar hemorrhage. In the closed claim study of MAC, 26 % of the eye injuries during retrobulbar block were associated with head movement. Retrobulbar block is a very effective block in providing analgesia for ophthalmic procedures, but it can be painful to perform, especially in patients with a high level of anxiety or the expectation of "painlessness". Sedation techniques which produce profound analgesia and a moderate level of sedation are ideal in these cases.

3) Postoperative management. Patients undergoing short procedures under MAC, including cataract, glaucoma, simple vitrectomy or minimal plastic surgery, can bypass Phase I recovery and enter Phase II recovery. (Phase I focuses on providing post-anesthesia care in the immediate post-anesthesia period, with basic life sustaining needs of the patient at the highest

priority and constant vigilance required. Phase II focuses on preparing the patient for care at home or in an extended care environment.) The average time in the PACU is about 30 to 60 minutes. Since ophthalmic procedures are associated with a high frequency of bradycardia or other arrhythmias, especially in geriatric patients, continuous ECG monitoring in the PACU is necessary.

The pain associated with eye surgery is usually mild to moderate and can be treated with oral or intravenous NSAIDs. However, if the patient's surgery is complicated by increased IOP, severe eye pain, nausea, and vomiting can occur. Therefore, an elevation in IOP needs to be ruled out before large dose of narcotics is administered for pain, or in patients with refractory PONV.

### 3. Ophthalmic Procedures and Their Implications to Anesthesia

1) Cataract surgery. The time to perform a cataract surgery varies from 10 minutes to 40 minutes depending on the density of the cataract, the patient's cooperation, and the skill and experience of surgeons. Pain control of the procedure can be achieved by either regional block (retrobulbar, peribulbar, or sub-tenon blocks) or topical anesthetics (tetracaine or lidocaine) with intracameral lidocaine, although the latter is gaining popularity currently. General anesthesia is reserved only for patients with severe mental or cognitive dysfunction, or for severe claustrophobia. Typically, one surgeon can performed 10 to 20 cataract surgeries per day.

Since the cataract surgery is very similar between cases, 10 to 20 procedures can be performed by a single surgeon per day. The small surgical incision without suture required for the cataract surgery makes topical anesthesia with mild sedation possible. Safely managing this patient population with significant comorbidity and maintaining smooth operating room work flow during quick turn-over between cases requires good team work. Adequate preoperative patient evaluation, efficient patient preparation on the day of surgery, careful titration of sedatives during MAC to make sure patients are comfortable without pain or movement, and rapid recovery in the PACU are all important aspects of anesthetic management. Adequate sedation, avoiding over or under sedation, is especially important during cataract surgery under topical or local anesthetics. Producing a cooperative patient with globe akinesis is a challenge to anesthesia providers; every patient has different underlying medical conditions, expectation of sedation, and response to medication. The "balance technique" is a combination of small doses of propofol and narcotics. It is superior to a larger dose of a single agent in the

prevention of pain during regional blocks, in the maintenance of sedation, and in avoiding over sedation leading to patient accidental movement when the drug effects wear off.

2) Glaucoma surgery (trabeculectomy, angle procedures, and tube shunt procedures (e.g. Ahmed Glaucoma Valve and other implants)). It takes approximately 30 to 60 minutes to perform a glaucoma procedure. Regional block, either retrobulbar, peribulbar, or sub-tenon block, is usually required for the procedure. The incidence of complications associated with retrobulbar block is about 1%, including globe perforation, retrobulbar hemorrhage, brain stem injection of local anesthetics, and oculocardic reflex.

The anesthesia consideration is similar to cataract surgery. However, cauterization, dissection of the conjunctival and scleral tissue, suturing, and manipulation of the iris are all necessary, leading to postoperative pain. Patients taking anticoagulants are usually advised to stop prior to surgery because they might increase surgical complications. A moderate level of sedation/analgesia is often needed to release patients' anxiety and pain if the regional block is incomplete, which occurs in 1-5% of cases. One surgeon can potentially perform 8 to 12 cases a day. Minimizing delay from human factors during case turn-over requires concise preoperative patient evaluation, preparation, and intraoperative management, and ensures the efficiency of the operating rooms.

3) Retinal surgery. The time needed for retinal surgery by vitrectomy alone varies from as short as 15 minutes for peeling of an epiretinal membrane to several hours for complex retinal detachment repair. It is usually performed under MAC with retrobulbar block. Scleral buckling is another method for retinal detachment repair, and involves placement of a silicone band or sponge around the sclera. This requires access to the orbit and extraocular space and is therefore more invasive compared to vitrectomy in terms of tissue injury and manipulation. Similar invasiveness is required for brachytherapy for choroidal melanoma. The procedure involves suturing a radioactive plaque directly to the sclera, which often requires deep dissection into the orbit as the largest plaques can reach up to 23 mm in diameter.

Anesthesia can be achieved by retrobulbar block with a relatively larger volume of local anesthetics plus MAC with adequate dosing of intravenous opiates and sedatives. Alternatively, general anesthesia can be utilized, depending on the surgeon's preference and patient's underlying medical conditions.

4) Strabismus surgery. It takes 15 to 30 minutes to repair one eye muscle during a strabismus repair procedure. However, it could take two to three hours to complete a multi-muscle repair in bilateral eyes.

Although strabismus repair can be performed under topical anesthetics and MAC for simple repair, e.g. one to two muscles in only one eye, the majority of procedures are under general

anesthesia. A cooperative patient under MAC during strabismus repair will ideally allow surgeons to check on the result of the procedure while in the operating room. The final tie-up of the adjustable sutures is usually performed several hours later in the post anesthesia care unit (PACU) after patients return to their baseline mental status from general anesthesia, which could potentially delay patient turnover in the PACU. When general anesthesia is used, laryngeal mask airway (LMA) is preferred since it causes less irritation to the oropharynx as well as fewer hemodynamic changes. However, one needs to keep it in mind that LMA is not a secured airway; the airway is difficult to control if laryngospasm occurs or the sealing of the LMA fails, especially when the patients' head and airway are remote from the anesthesia provider during ophthalmic procedures. Strabismus repair causes the highest incidence of oculocardiac reflex, especially when the medial rectus ocular muscle is manipulated. The oculocardiac reflex mainly causes sinus bradycardia, but also may cause other types of dysrhythmia, including PAC, PVC, atrioventricular heart blocks and asystole. Vigilant monitoring of the cardiac rhythm by electrocardiogram and prompt treatment is imperative. The incidence of postoperative nausea and vomiting (PONV) is very high in strabismus surgery making prophylactic treatment of PONV necessary.

5) Corneal transplantation. There are several techniques of corneal transplantation, namely Penetrating Keratoplasty (PKP), Descemet's Stripping Automated Endothelial Keratoplasty (DSAEK), Descemet's Membrane Endothelial Keratoplasty (DMEK), Deep Lamellar Endothelial Keratoplasty (DLEK), and Keratoprosthesis. The majority of corneal transplantation is performed under MAC with retrobulbar block, although general anesthesia is still needed for uncooperative patients, prolonged combined procedure with vitrectomy, in patients where retrobulbar block is contraindicated because of their anatomy (e.g. very long axis of the globe or very tight fissure or small orbit), or after trauma.

Depending on which technique is used, corneal transplantation takes about one to two hours to complete. The majority of the surgery is under MAC with retrobulbar block, although general anesthesia is also a common practice. Between the time that the diseased cornea is removed and the new cornea is secured, patient's globe is fully open and the IOP is the same as atmosphere. Any movement in the patient can cause a loss of intraocular contents leading to blindness. Therefore, during this critical time period, a motionless patient is absolutely required. If patients are under MAC it is important to provide moderate level of sedation to relieve anxiety and pain but also to avoid over sedation. When elderly patients wake up from deep sedation in the middle of the procedure, not only they can move without warning, but their movement is also difficult to control due to their delirium and confusion. If the patient is under general anesthesia, a muscle relaxant is usually used to provide total paralysis until at least four sutures are secured on the new cornea. The administration of muscle relaxants are guided by a nerve stimulator. The recovery time from a muscle relaxant can be considerably

longer in geriatric patients depending on the drug dose, the half-life, the patient's body temperature, kidney function, and hepatic function. It is always a safe practice to give reversal medication (neostigmine) only after the surgery is completed, the surgical table is turned back to the control of the anesthesia providers, the patients are suctioned before weaning the anesthetics, and a strong 4 of four twitches is demonstrated. Sometimes, waiting until the muscle relaxant is maximally metabolized and excreted by the kidney before reversal is given can enhance complete recovery. Suctioning of the patients' airway before turning off the anesthetics is also an important practice to prevent coughing and bucking. If there is no contraindication, extubation of patients' endotracheal tube while the spontaneously breathing patient is at a deep anesthetic level can effectively prevent coughing and bucking, especially in asthmatic, COPD patients, or patients having acute upper respiratory infection. Infusion of propofol as total intravenous anesthesia (TIVA) or as a supplement to volatile agents can also effectively prevent coughing and bucking in smokers and postoperative delirium.

6) Plastic surgery. Ptosis repair or blepharoplasty takes about 30 minutes to two hours depending on the extensiveness of the repair. It is performed almost exclusively under MAC with injection of local anesthetics. The presence of 1:100,000 (10 mcg/ml) concentration of epinephrine with 2% lidocaine can potentially cause tachycardia, hypertension, and dysrhythmia after the injection, technically mimicking a stress test in an elderly patient. The concentration of epinephrine contained in the lidocaine injection should be further diluted to 1:200,000 or removed totally in patients who cannot tolerate tachyarrhythmia due to their underlying cardiac diseases. It is very important to monitor the total dose of lidocaine injected during the procedure in order to prevent lidocaine toxicity, especially if the procedure is prolonged and multiple injections are required. In general, the maximum dose of lidocaine without epinephrine is 3 to 5 mg/kg, and 5 - 7 mg/kg with epinephrine. Orbitotomy and dacryocystorhinostomy (DCR) are much more invasive in terms of tissue injury and potential of bleeding compared to eyelid procedures, and take about one to two hours to finish. Procedures involving the bony structure of the orbital wall or the nasal opening of the tear duct have the potential for greater pain. Most surgeons prefer to perform both procedures under general anesthesia because of their concern that patients' pain control may not be adequate by MAC, exacerbating patient movement intraoperatively. However, some experienced surgeons prefer to perform these procedures under MAC with injection of local anesthetics based on their belief that general anesthetics, especially the volatile agents, will cause significant dilatation of the blood vessels in the surgical field leading to excessive bleeding, making the visualization of the anatomy more difficult and increasing the risk of surgical complications. At UCLA, both MAC and general anesthesia are provided depending on the surgeons' preference and the experience and comfort level of the anesthesia providers. Laryngeal Mask Airway is used in most of the orbitotomy and DCR cases unless aspiration becomes a major concern, and

in cases bleeding is highly possible (e.g. hemangioma of the orbit or repeat DCR), in which cases endotracheal intubation is preferred.

Most ophthalmic surgery is performed to improve patients' vision (cataract, corneal transplantation, retinal detachment) or prevent further deterioration (glaucoma, diabetic retinopathy), both of which goals are important in improving the elderly patients' quality of life. For health care providers, taking care of the geriatric population undergoing ophthalmic surgery requires tremendous work, but is very rewarding.

## References:

1. Jung S, Coleman A, Weintraub NT. Vision screening in the elderly. *J Am Med Dir Assoc* 2007;8(6):355-62.
2. Monestam E, Wachmeister L. Impact of cataract surgery on the visual ability of the very old. *Am J Ophthalmol* 2004;137(1):145-55.
3. White PF, White LM, Monk T, et al. Perioperative care for the older outpatient undergoing ambulatory surgery. *Anesth Analg* 2012;114(6):1190-215.
4. Bhananker SM, Posner KL, Cheney FW et al, Injury and liability associated with monitored anesthesia care: a closed claims analysis. *Anesthesiology* 2006;104(2):228-34.
5. Greenberg PB, Liu J, Wu WC, et al. Predictors of mortality within 90 Days of cataract surgery. *Ophthalmology* 2010;117(10):1894-9.
6. Glantz L, Drenger B, Gozal Y. Perioperative myocardial ischemia in cataract surgery patients: general versus local anesthesia. *Anesth Analg* 2000;91(6):1415-9.
7. Parikh SS, Chung F. Postoperative delirium in the elderly. *Anesth Analg* 1995;80(6):1223-32.
8. Phillips MB, Bendel RE, Crook JE, Diehl NN. Global health implications of preanesthesia medical examination for ophthalmic surgery. *Anesthesiology* 2013;118(5):1038-45.
9. White PF, Kehlet H, Neal JM, et al. The role of the anesthesiologist in fast-track surgery: from multimodal analgesia to perioperative medical care. *Anesth Analg* 2007;104(6):1380-96.
10. Vann MA, Ogunnaike BO, Joshi GP. Sedation and anesthesia care for ophthalmologic surgery during local/regional anesthesia. *Anesthesiology* 2007;107(3):502-8.
11. Fang ZT, Keyes MA. A Novel mixture of propofol, alfentanil, and lidocaine for regional block with monitored anesthesia care in ophthalmic surgery. *J Clin Anesth* 2006;18(2):114-7.