

Minimizing Problems With Filtering Surgery

Intraoperative complications.

BY SANDRA M. JOHNSON, MD

Your attention to detail in the pre- and intraoperative setting can contribute to a smoother operative course.

PREOPERATIVE PLANNING

Reviewing your patient's health status and medications preoperatively is mandatory. Someone with poorly controlled blood pressure or heart rate is at greater risk for suprachoroidal hemorrhage (SCH). I like my anesthesia team to know that the control of vital signs is important in glaucoma surgery. Anticoagulant use can contribute to more bleeding should an SCH occur, and any inessential use of aspirin or nonsteroidal drugs can easily be stopped 2 weeks prior to surgery.¹ The discontinuation of more necessary anticoagulants for stroke prophylaxis, for example, needs to be determined on a case-by-case basis with the prescribing physician. The monitoring of warfarin dosing in patients undergoing filtering surgery should be up to date.

To lessen coughing during surgery, I instruct patients on inhalers and/or nebulizers to use their medications on the day of surgery. I ask all patients to let the operative team know if they need to cough or move so that care may be taken to stabilize the eye.

During surgery, note the red reflex. If you observe a choroidal effusion, the most important thing to do is to close the wound as quickly as possible to increase the IOP. This will help restrict the size of the effusion and limit any hemorrhage before it becomes expulsive. My scrub technician has my 10–0 nylon loaded in case I need it quickly.

ANESTHESIA

I prefer to use topical lidocaine 2% jelly preoperatively, after administering some tetracaine and povidone-iodine 5% drops, followed by a subconjunctival injection of preservative-free 1% lidocaine at the start of the case. It is easy to administer more lidocaine as sub-Tenon anesthesia (Connor anesthesia cannula; Bausch + Lomb/Storz Ophthalmic Instruments, Rochester, NY) when the conjunctival incision is limbus based and in a quadrant, but the

drug can also be administered with a fornix-based wound or in the inferior nasal quadrant with a small conjunctival and Tenon incision. Using topical and sub-Tenon anesthesia avoids a retrobulbar block and the potential for a retrobulbar hemorrhage, especially in a patient who should not stop anticoagulants. Furthermore, using topical anesthesia avoids adding volume in the orbit around an optic nerve with glaucomatous damage that could be prone to ischemic injury or further damage from elevated IOP due to the block.

Consider a lid block for a patient who has blepharospasm, small fissures, or other lid-related situations that may prompt squeezing of his or her eyelids against the speculum and may make shallowing of the anterior chamber and choroidal effusion more likely.

CONJUNCTIVA

Torn conjunctiva can render closing the flap at the end of the case difficult and lead to postoperative wound leaks. The use of conjunctival forceps such as Hoskins (Katena Products, Inc., Denville, NJ) is advisable for hold-

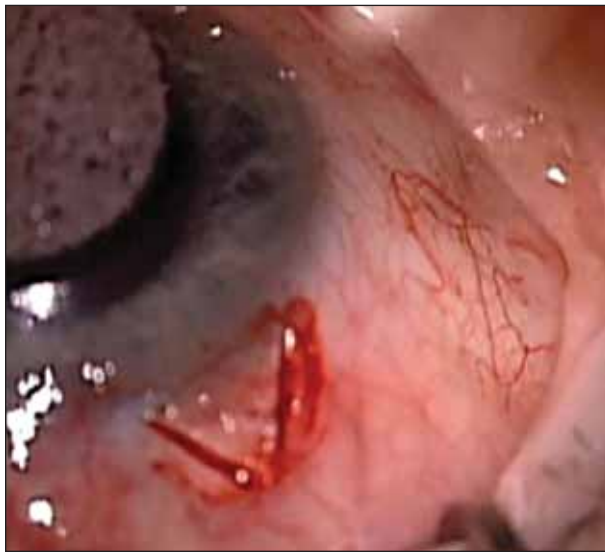


Figure 1. The surgeon places the trabeculectomy flap in the quadrant to avoid bleeding from the rectus muscles. The conjunctival incision is several millimeters larger than the base of the scleral flap to lessen the amount of conjunctiva to be manipulated.

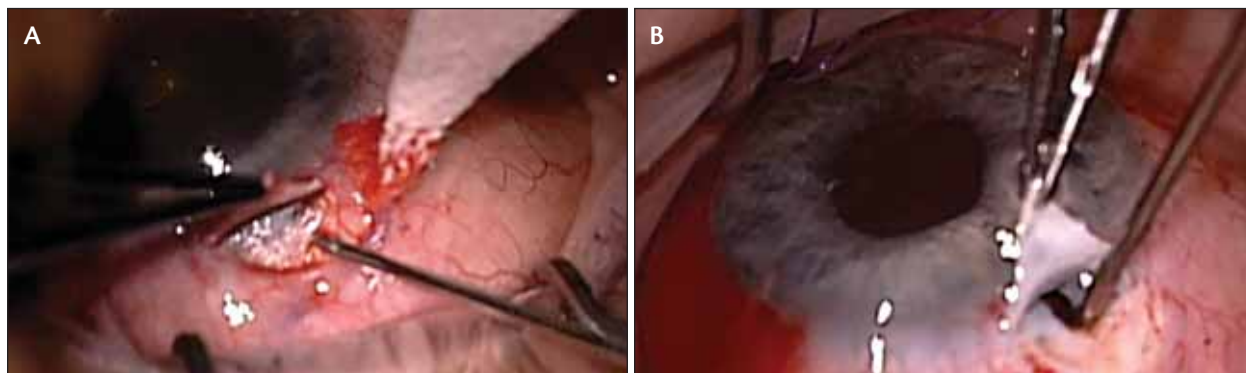


Figure 2. Pinpoint cautery is useful for coagulating small bleeders such as scleral perforators uncovered during the flap's creation (A). The same cautery tip can be useful for coagulating small bleeders at the sclerostomy (B).

ing conjunctival tissue. When exposure is required, preferentially grasp the Tenon layer. If a patient appears to have minimal or very thin Tenon tissue, a fornix-based flap will require less conjunctival manipulation. This approach is also preferable for eyes with conjunctival adhesions at the limbus, because scarring in this location can lead to buttonholes during limbus-based dissection. I prefer to work with small conjunctival incisions to minimize how much conjunctival tissue is manipulated during the case. Working in a quadrant makes the disturbance of an extraocular muscle and its vascular supply less likely and helps to maintain a clear view in a bloodless field (Figure 1). Using a fixation suture in the superior or inferior peripheral cornea also avoids bleeding compared with a superior rectus traction suture. I place the suture at 12 or 6 o'clock so that I can maintain the orientation of where I am working, which helps me to avoid muscles.

When closing the conjunctiva, use your technique for the most watertight wound. For a limbus-based filter, I prefer to place some interrupted sutures in the Tenon layer to approximate it and then close the conjunctiva with a running 10-0 nylon suture on a BV-100 needle (Ethicon, Inc., Somerville, NJ), locking about every third bite. If the conjunctiva is gaping, then I lock bites more often to avoid tearing the tissue. If tissue cannot be closed, then an allograft material such as Ambio5 (IOP Ophthalmics, Costa Mesa, CA) can be used. If you prefer Vicryl (Ethicon, Inc.) for closing, I suggest a double running suture, because this material degrades more quickly than nylon. To verify that there are no leaks prior to leaving the OR, I check the wound with fluorescein at the end of the case, as I inject balanced salt solution into the anterior chamber.

To ensure the eye will maintain a properly formed anterior chamber, a fornix-based wound also needs to be watertight and should be checked with fluorescein if you feel any concern about leakage. Relaxing incisions can be made in the posterior conjunctiva in the fornix, not through the

Tenon capsule, if you need to pull more conjunctiva down to the limbus for a closure without tension. If the conjunctiva is prone to tears in a fornix-based wound, suturing the conjunctiva directly to the episclera can help stabilize the closure.

SCLERA

Before incising sclera, blanch the episclera to prevent bleeding. I extend the blanching to where I expect to place my sutures. It is best to be proactive and to avoid bleeding in order to maintain a good view of the details of the surgery. The scleral flap should be at one-half to two-thirds scleral thickness to maintain its integrity during the case, as when it is retracted. When a patient has thin sclera, I make a larger flap, because I expect less restriction of flow than with my usual 3- X 3-mm triangle and I have more tissue with which to cover the sclerostomy or the Ex-Press Glaucoma Filtration Device (Alcon Laboratories, Inc., Fort Worth, TX) when I close with sutures. Thin flaps are more likely to have problems with cheese wiring. If the flap you create is inadequate or amputated, it may be best to make a new, adjacent one to ensure adequate coverage of the sclerostomy. You can sew an amputated flap to the limbus and/or use a graft of banked sclera or even an autograft from the patient to cover the limbal aspect in order to maintain the anterior chamber when closing.

When I am about 90% done dissecting my flap toward the limbus, I apply mitomycin C (MMC) to avoid unexpectedly entering the anterior chamber and possibly exposing the corneal endothelium to the antifibrotic.² The flap is finished after the MMC is washed away. It is essential to bring the flap to the edge of the cornea to avoid a sclerostomy that is too posterior and exposes vitreous when the sclerostomy is made. As I make the flap, I change my cautery to a 23-gauge blunt tip that can focally cauterize scleral perforators with minimal shrinkage of the flap or its bed (Figure 2). Shrinkage can lead to misalignment when sutures are placed



Figure 3. Basal flap sutures reduce filtration the most and allow for easier stabilization of the anterior chamber.

in the flap. I ask my scrub technician to dye my MMC and sponges with a sterile skin pen. This trick makes them easy to visualize, facilitates the sponges' accurate placement, and makes leaving any of them behind unlikely.

When I suture the flap, I place two basal sutures to avoid excess flow, which I find helps to stabilize the eye more quickly in the OR and allows me to place fewer sutures (Figure 3). The number of sutures is determined by the injection of balanced salt solution through the paracentesis to ensure there is flow under the flap with a maintained anterior chamber.

FISTULA

When I am ready to create the sclerostomy and iridectomy, I prefer for the instruments leading up to suturing to be ready and the suture loaded so that I can move efficiently through this part of the procedure when the IOP drops the lowest. If the pressure is above 30 mm Hg preoperatively, I make the paracentesis and then depress it several times before opening the eye under the flap. If the eye is at increased risk of an SCH (eg, high preoperative IOP, prior vitrectomy, old age), I inject a viscoelastic such as Amvisc (Bausch + Lomb, Rochester, NY) into the anterior chamber to maintain its form before entering the eye in a traditional trabeculectomy. I again have my pinpoint cautery (Medtronic, Inc., Minneapolis, MN) ready in case of any bleeding at the site of the sclerostomy (Figure 2). I always double-check that there is no bleeding before suturing the flap. In the case of filtering surgery with the Ex-Press, proper centration of the entry site under the flap and an appropriately made tunnel for the device's placement with one nee-

dle entry helps to ensure the device's stability, avoid overfiltration, and facilitate maintenance of the anterior chamber. Again, I have my pinpoint cautery ready in case of any bleeding at the site of the sclerostomy (Figure 2).

IRIS

I instill pilocarpine 1% preoperatively to constrict the pupil, which promotes a more basal iridectomy and protects the lens in a phakic eye. The instrument used to grasp the iris for the iridectomy should enter the eye parallel (not perpendicular) to the iris to avoid grasping of the ciliary body or perforation of the zonules. A pseudophakic eye with a very deep anterior chamber may not need an iridectomy.³ The 23-gauge blunt cautery is again useful for coagulating any pinpoint bleeding from the peripheral iris or ciliary body beneath. I also prefer to avoid an iridectomy in aphakic eyes with open angles. It is not needed, because the iris tends to fall away from the angle in the absence of the lens. Otherwise, I may encounter vitreous with the iridectomy, which will make the case more complicated. Another option in aphakic eyes is the use of the Ex-Press, which does not require an iridectomy.

VITREOUS

Any vitreous present in the anterior chamber before surgery can become incarcerated in the fistula or Ex-Press and subsequently inhibit filtration or cause retinal traction. Vitreous therefore must be removed, and I find an anterior vitrectomy away from the site of filtration to be the most effective technique. I can easily create a clear corneal incision with a keratome and use the paracentesis as an anterior chamber maintainer.

If you encounter vitreous when creating the fistula, it may be prudent to close that flap completely and to make a new adjacent one that extends farther into the peripheral cornea to avoid a second presentation of vitreous. If you encounter vitreous humor during the iridectomy, consider performing a Weck-Cel (Beaver-Visitec International, Waltham, MA) vitrectomy, followed by a viscoelastic tamponade over the iridectomy to help maintain its position behind the iris.

Whenever you have encountered vitreous during filtration surgery, it is best to close the eye tightly to avoid shallowing of the anterior chamber in the early postoperative period, which encourages the forward prolapse of vitreous. You can perform laser suture lysis in the weeks after surgery to allow the IOP to decrease gradually.

CONCLUSION

As with many surgical procedures, you must thoughtfully execute each step of a trabeculectomy—beginning preoperatively—to avoid intra- and postoperative problems. Your efforts should contribute to successful results.

A video showing Dr. Johnson's use of dyed sponges for filtering surgery is available at <http://eyetube.net/video/purple-sponges>.



Sandra M. Johnson, MD, is an associate professor of ophthalmology at the University of Virginia, where she is on the Cataract and Glaucoma Service and is the residency program director. She acknowledged no financial interest in the products or companies mentioned herein. Dr. Johnson may be reached at (434) 924-2808; smjeyes@gmail.com.



1. Jeganathan VSE, Ghosh, Ruddle JB, et al. Risk factors for delayed suprachoroidal haemorrhage following glaucoma surgery. *BJO*. 2008;92:1393-1396.
2. McDermott ML, Wang J, Shin DH. Mitomycin and the human corneal endothelium. *Arch Ophthalmol*. 1994;112(4):533-537.
3. de Barros DSM, Da Silva RS, Siam GA, et al. Should an iridectomy be performed as a part of trabeculectomy? Two surgeons' clinical experience. *Eye*. 2009;23(2):362-367.

Postoperative complications.

BY JONATHAN S. MYERS, MD

Trabeculectomy remains the most common incisional surgery for glaucoma, especially for advanced disease. Four decades of performing filtering surgery, and more than 2 decades' experience with antimetabolites, have allowed glaucoma surgeons to become well versed in the procedure's strengths and weakness. Although it cannot be eliminated, many of the ophthalmologist's choices can reduce the risk for a given patient. For example, intraoperative judgment and technique play a key role in the rate of shallow chambers, hypotony, hyphema, wound leaks, and late bleb leaks. Risk factors such as high blood pressure can be improved, as can a patient's risk of suprachoroidal hemorrhage. Other risk factors are immutable such as neovascular glaucoma and filtering surgery's higher risk of failure in these eyes compared to those with open-angle glaucoma. The rates of postoperative complications therefore vary greatly based on the patients studied and the techniques used.¹⁻³

SUPRACHOROIDAL HEMORRHAGE

Suprachoroidal hemorrhage is among the most potentially devastating complications. The risk is greatest in patients with high IOP, advanced age, high blood pressure, and vitrectomized eyes. Reducing IOP for a time prior to surgery with maximal medical treatment may help. When this is not possible, the surgeon may wish to consider the intravenous administration of drugs immediately prior to surgery. Patients' blood pressure should be controlled preoperatively when possible.

Thick, tightly sutured flaps reduce the early postoperative risk of suprachoroidal hemorrhage by avoiding early postoperative hypotony, a significant risk factor for hemorrhage.⁴ Releasable sutures may help the surgeon to achieve a staged IOP reduction, although delayed hemorrhages may rarely occur upon the suture's release. The patient's reduced postoperative activity, especially bending and straining, is critical.

INFECTION

Early

Early postoperative infections such as endophthalmitis are rare after trabeculectomy. It is unclear if the choice of postoperative antibiotic has an influence on this risk, but the data from studies on cataract surgery suggest that the preoperative preparation should include povidone-iodine.⁵ Watertight wound closure also seems important in terms of infection prophylaxis as well as for minimizing early leaks, which can lead to bleb failure or a return to the OR.

The plethora of techniques for closing the wound suggests that many approaches work well when executed meticulously. Most surgeons agree that limbal incisions (fornix-based flaps) are more easily performed when the ophthalmologist is unassisted and operating with topical anesthesia. Some surgeons feel this approach encourages low, diffuse blebs that are less prone to leaks and dysesthesia. As discussed later, however, the physician's technique for applying the antimetabolite may be a larger issue in this regard. Limbal (fornix-based) incisions are generally more prone to leaks than posterior (limbus-based) incisions, although the vast majority of limbal wound leaks will close on their own. Patients must understand the importance of not rubbing their eyes.

Late

Late postoperative infections are usually a result of bleb-related factors such as leaks and thin tissue.



Figure 1. An avascular, focal bleb that has developed blebitis.

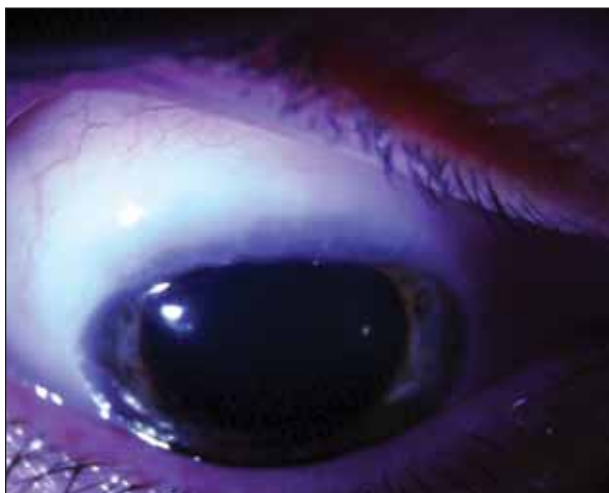


Figure 2. Hypotony and an avascular bleb after a trabeculectomy with more mitomycin C used than necessary (in retrospect).

Although individual patients' tissue-healing characteristics play a central role in the nature of the bleb that develops, there is increasing consensus that applying mitomycin C or 5-fluorouracil to a wider area of the sclera and conjunctiva promotes more diffuse and less avascular blebs (compared to those created with a focal application of antimetabolites [Figure 1]).^{6,7} These lower, wider blebs may be less prone to leaks, infection, dellen, and dysesthesia.

FAILURE AND FLOW

Factors that predispose filtering surgery to failure include race, internal and external inflammation, prior surgery, and the type of glaucoma. The tissue's viability for filtering surgery may be improved by the cessation of particularly irritating topical medications or the initiation of a short course of steroids. Greater antimetabolite exposure may also help. Higher flow through the fistula—to the extent that the IOP and chamber management allow—may improve the surgical outcome.

Shallow chambers are more likely with high flow. Small eyes with small chambers preoperatively are at increased risk, as seen in phakic eyes with angle-closure glaucoma. These eyes have a higher risk of aqueous misdirection. Uveitis are prone to aqueous shutdown, hypotony, and shallow chambers. Thick flaps and tight closure with releasable sutures may greatly reduce the incidence of shallow chambers and aqueous misdirection. Viscoelastics temporize and may allow a more gradual transition to lower pressure, but the viscoelastic often does not last long enough, requiring repeated injections if the original closure was not sufficiently restrictive. Hypotony maculopathy may follow if low pressures persist, especially in young, white, myopic patients (Figure 2).⁸ These individuals do best with a

tight closure to start, but they may be managed postoperatively with bleb compression sutures, transconjunctival suturing of the flap, or a full revision. Most fare well if treated before permanent macular folds or pigmentary changes develop in the macula.⁹

THE PATIENT

The patient's role in the success of filtering surgery should be acknowledged. His or her adherence to prescribed medical therapy, the postoperative examination schedule, and activity restrictions is critical. Repeated perioperative communication by the surgeon, surgical coordinator, and postoperative nurses in addition to the provision of written materials that stress to patients the importance of their behavior may help in this regard. These steps, however, cannot overcome all obstacles.

A successful trabeculectomy often involves active postoperative management; it is not a "fire and forget" procedure. This may make filtering surgery less than an ideal choice for patients who have difficulty using drops, restricting their activities, or keeping follow-up visits.

CONCLUSION

As has often been said, science and art must combine for successful surgery. The ophthalmologist must assess the many factors influencing a patient's individual needs and risks and then weigh these against the strengths and weaknesses of the proposed procedure in his or her hands. Trabeculectomy allows some, but not complete, tailoring of the surgery to the patient's individual characteristics to maximize its benefits while minimizing its risks. Through this customization, thoughtful, experienced surgeons can distinguish themselves as they serve their patients' needs. □

Jonathan S. Myers, MD, is an associate attending surgeon at Wills Eye Institute in Philadelphia. Dr. Myers may be reached at (215) 928-3197; jmyers@willseye.org.



1. Jampel HD, Musch DC, Gillespie BW, et al; Collaborative Initial Glaucoma Treatment Study Group. Perioperative complications of trabeculectomy in the collaborative initial glaucoma treatment study (CIGTS). *Am J Ophthalmol*. 2005;140(1):16-22.
2. Gedde SJ, Herndon LW, Brandt JD, et al. Surgical complications in the Tube Versus Trabeculectomy Study during the first year of follow-up. *Am J Ophthalmol*. 2007;143(1):23-31.
3. de Barros DS, Da Silva RS, Siam GA, et al. Should an iridectomy be routinely performed as a part of trabeculectomy? Two surgeons' clinical experience. *Eye (Lond)*. 2009;23(2):362-367.
4. Jegannathan VS, Ghosh S, Ruddle JB, et al. Risk factors for delayed suprachoroidal haemorrhage following glaucoma surgery. *Br J Ophthalmol*. 2008;92(10):1393-1396.
5. Ciulla TA, Starr MB, Masket S. Bacterial endophthalmitis prophylaxis for cataract surgery: an evidence-based update. *Ophthalmology*. 2002;109(1):13-24.
6. Cordeiro MF, Constable PH, Alexander RA, et al. Effect of varying the mitomycin-C treatment are in glaucoma filtration surgery in the rabbit. *Invest Ophthalmol Vis Sci*. 1997;38(8):1639-1646.
7. Jones E, Clarke J, Khaw PT. Recent advances in trabeculectomy technique. *Curr Opin Ophthalmol*. 2005;16(2):107-113.
8. Fannin LA, Schiffman JC, Budenz DL. Risk factors for hypotony maculopathy. *Ophthalmology*. 2003;110(6):1185-1191.
9. Costa VP, Arcieri ES. Hypotony maculopathy. *Acta Ophthalmol Scand*. 2007;85(6):586-597.