An Update on Trabeculectomy

Merih Onol[1]

ABSTRACT

Current treatments of glaucoma are directed toward lowering the intraocular pressure (IOP), the major modifiable risk factor associated with the disease. Surgical treatment is a key element in the glaucoma treatment algorythm. Trabeculectomy is one of the oldest glaucoma surgeries. Glaucoma surgical techniques have been evolved in the last twenty years and despite recent advances in glaucoma surgical techniques, trabeculectomy is often regarded as the gold standard of surgical care.

Keywords: Trabeculectomy, mitomycin-C, penetrating surgery, glaucoma, bleb

Penetrating surgeries are the oldest surgical technique employed in glaucoma and they are most effective surgeries in decreasing intraocular pressure (IOP), which are also termed as fistulating or filtrating surgeries. Although there are many filtering-penetrating surgeries addressed briefly, trabeculectomy, which was described by Cairns[1] and have been modified over time, will be discussed in this chapter. Among these, the trabeculectomy is the best known and widely accepted technique by glaucoma surgeons.

A. INDICATION AND TIMING

The primary indication is IOP that cannot be controlled by medical therapy and presence of advanced glaucomatous damage. In glaucoma clinics, even at first presentation, surgical indication can be first consideration in a patient with above-mentioned profile particularly if the patient lost his/her contralateral eye due to same reason or if there is glaucoma blindness in the family history or if cornea is thin. In patients with single eye, the fear of losing the eye is extreme. Thus, the patient should be asked: the risk for losing eye is extremely low but what will you do if you don't undergo surgery?

In patients attending regular control visits, surgical indication is established if there is progression on periodical diagnostic tests (visual field test, optical coherence tomography [OCT] in particular) or IOP cannot be maintained at target pressure. Given the longer life expectancy, younger glaucoma patients should be considered as more tended to surgery.

When the need for surgery is recognized based on examination, the patient should be informed that it is needed to confirm whether IOP elevation is unexpected by assessing one week after; thus, the decision will be made in the second visit. Such an expectation has favorable effect in the patient, allowing the patient to be prepared mentally. In addition, the patient is asked to withdraw anticoagulant agents, emphasizing determinedness of clinician.

Exfoliation syndrome (XFS) is another important determinant of surgical indication. The above-mentioned indications become definite when XFS is detected, leading prompt surgery. In glaucoma clinics, surgical indication is determined most commonly in XFS cases[2, 3].

Another indication is intolerance to medical therapy and incompliance to treatment which is often seen in elder individuals living alone. The patient should be informed about XFS and blindness due to trabecular occlusion which is most commonly seen and operated form of glaucoma.

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1- Prof. Dr., Gözakademi Göz Kliniği, Bodrum, Muğla, Türkiye

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Correspondence Address:
Merih Onol
Gözakademi Göz Kliniği, Bodrum, Muğla, Türkiye
Phone: +90 532 216 0575
E-mail: meonol@gazi.edu.tr

Another indication include sensitivity or allergy against drugs used in eye and periocular area, which is seen in multi-drug therapies (Figure 1). In some cases, it is very common and drug changes aren't sufficient to solve the problem, challenging indications. The eye and periocular area return normal after surgery (Figure 2).

In recent years, surgical approaches have been changed in patients with angle closure glaucoma. Filtering surgery alone can be associated with severe complications (such as malignant glaucoma) in these cases. Thus, lens extraction-phacoemulsification (PHACO) first can strength surgeon's hand. The anterior chamber gains volume; iris and angle are retracted; and the case approximates to open angle. Filtering surgery in same session (PHACO + trabeculectomy) is more successful with better control after surgery. In addition, these patients should be convinced and transparent lens extraction by PHACO should be performed in the contralateral eye with angle closure, protecting at early phase.

Figure 1: *Eyelid allergy due to use of multiple anti-glaucoma drops drugs. Surgical treatment decision was made due to failure of drug changes and insufficient IOP reduction.*

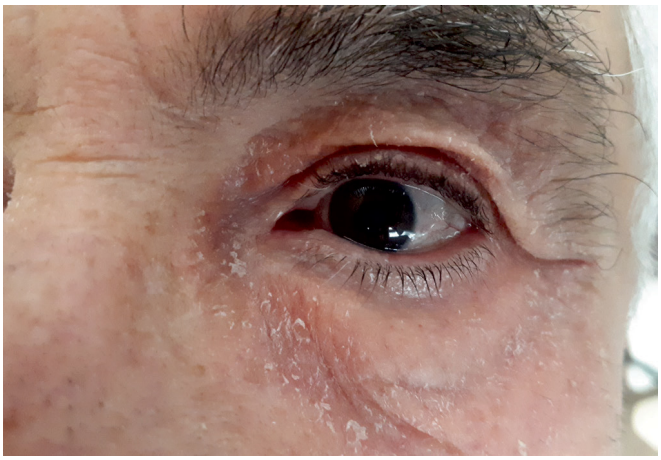

Figure 2: *Desquamation due to rapid recovery 1 week after glaucoma surgery in the patient in Figure 1.Healthy skin will develop within a few weeks.*

Penetrating surgery is indicated in the early stages of neovascular glaucoma. In such patients, retinal pathology approaches (panretinal laser etc.) should be employed as part of preparation to surgery; intravitreal anti-vascular growth factor should be injected, ensuring the patient can undergo penetrating surgery without bleeding.

B. PATIENT EXPECTATION IN PENETRATING SURGERY

As with all glaucoma surgeries, the patients should be informed that some complications which can be relieved easily may develop after surgery in penetrating surgery, a second intervention to adjust humor aqeuous (HA) flow may rarely be required, and they may experience blurred vision (drug effect, regression in astigmatism) for a short while. Informing patients about the fact that the surgery is performed to protect his/her vision and visual field and that vision will not be improved but no blindness will occur improves trust relationship between surgeon and patient and relieves concerns of the patients. In addition, patients should also be informed that, unlike cataract surgery which may not require control visits, the glaucoma surgery warrants control visits even after a successful surgery unlike cataract surgery.

C. PENETRATING SURGERY TECHNIQUES

In glaucoma surgery, the aim is to further reduce IOP which cannot be lowered by medical therapy and to prevent progression in visual field loss.

McKenzie first described sclerotomy in 1830, reporting successful outcomes. Von Graefe reported that humor aqueous leaked to subconjunctival area in some patients underwent peripheral iridectomy for angle-closure glaucoma and IOP levels had excellent course in these patients; he also described filtration bleb for the first time. Holth described anterior lip sclerotomy in 1906 and iridencleisis in 1907. Trepanation was first described by Elliot in 1909, which became highly popular. In 1968, Cairns described trabeculectomy which is still most widely used technique today[1-3].

Here, we briefly discussed several surgical techniques in a historical point of view, which were widely used in the past but abandoned with the introduction of trabeculectomy.

1. Iridencleisis

In iridencleisis, iris is squeezed by retracting between scleral limbal incision after opening sclera and wound closure is prevented by foreign body effect due to iris. Thus, humor aqueous efflux to subconjunctival region is achieved through the fistula. If peripheral iris is squeezed to scleral space as with peripheral iridectomy, it is called peripheral iridencleisis. However, if large iris tissue is squeezed, it is called as complete iridencleisis[2].

2. Elliot's trephination

In the Elliot's trephination first described by Elliot in 1909, sclera-limbal scleral block is removed as a perforation using a trephine (1.5-2 mm in diameter), allowing HA efflux. In preliminary practice, sclera-limbal scleral block was removed completely and hypotonia was commonly seen after surgery. In addition, endophthalmitis was also common due to loss of scleral flab protecting eye. Thus, in subsequent years, trephination was performed after uplifting scleral flap, improving success of the procedure. Thus, the method is termed as Elliot's trephination with scleral flap. The method appeared as a model for trabeculectomy and was commonly used before trabeculectomy era.

The common complications included loss of sharpness of trephine, invasion of scleral portion to be removed, iris-lens traumas in sudden penetration into anterior chamber, which could be relieved by trabeculectomy[2].

3. Trabeculectomy

In this section, we discuss preoperative behaviors, surgical steps, perioperative problems and key points in addressing these problems.

a. History and philosophy of surgery

The trabeculectomy was first described by John Edward Cairns in 1968[1]; since 1968, several modifications have been established and the method has become most commonly adopted and performed penetrating surgery. Although many novel surgical methods have been described, trabeculectomy won in comparative studies and it is always preferred in cases with advanced glaucoma where low pressure is desired.

The glaucoma surgeons, who have been long performed the technique, have found individual modifications and they maintained their individual modifications with authenticity as they got favorable results.

When Cairns first described trabeculectomy, he used extremely strict sutures for scleral flab. The aim was to drain HA through internal drainage channels. However, it was seen that subconjunctival bleb was developed in 35% of cases and these cases were more successful in lowering IOP. In 1970, Watson emphasized the success in cases with bleb formation; thus, today, scleral flap is sutured strictly that is sufficient to ensure HA efflux towards subconjunctival area.

The aim of trabeculectomy is to ensure HA drainage into episcleral space through scleral window formed. The HA should not be drained out of eye. Thus, scleral sutures should be lax while conjunctival sutures should be strict. It is extremely important in preventing early and delayed infections. The HA efflux occurs through narrow fistulas by fibrosis development over time. Thus, these surgeries are also termed as fistulating surgeries. The HA is absorbed by episcleral and orbital veins at subconjunctival area and drains into systemic circulation.

The fistula is a complication in all surgeries; however, success depends on fistula formation in penetrating surgeries. Anti-fibrotic agents/anti-metabolites (mitomycin C and 5-fluorouracil) given during surgery and bleb massage techniques after surgery aims to ensure viable fistula and prevent closure of fistula by fibrotic tissue developed at subconjunctival area and episclera.

However, fibrotic activity prevails and even excellent blebs can be closed, warranting new surgical interventions (bleb revisions, new penetrating surgery, Seton surgery etc.). This should be discussed with patient.

Trabeculectomy is an inexpensive, excellent surgery that can prevent blindness by ensuring low pressure in cases with advanced glaucoma; in addition, it is associated with less complications when performed by an experienced surgeon and the postoperative period can be well-managed with timely interventions.

b. Preoperative period

Counseling: It is important to provide detailed information about surgery to the patient for avoiding misunderstanding and problems in the future. The patient should be informed that the disease is rapidly progressing, that medical therapy is insufficient and advanced glaucoma damage will progress to blindness. Again, the patient should be informed that, in rare instances, there may a slight decrease in vision in case of advanced glaucoma but this is a better option when compared to progression to blindness if surgery isn't performed. The patient should be told that the present glaucoma-related damage will not regress but we can protect what we already have.

The patient should know that there may be problems that can be managed readily. In addition, there may be irritation or burning occasionally, which are harmless. Again, patient should be told that the fistula may be narrowed in the future and a new surgery may be needed.

Preoperative preparation: Topical parasympathomimetics (pilocarpine), adrenergic agonists (brimonidine) and systemic anticoagulant or antiaggregant agents should be withdrawn one week before surgery. If there is topical agent-related conjunctival inflammation which seemed to enhance fibrosis, mild steroid therapy may be initiated[3]. Systemic diseases such as diabetes mellitus or hypertension should be under control before surgery. To reduce risk, oral acetazolamide tablet should be given one hour before surgery while 20% mannitol infusion is performed 30 minutes before surgery in patients with high pressure. When pilocarpine is dropped one hour before surgery, pupil dilatation is prevented and peripheral iridectomy can be performed in a rapid and convenient manner since iris root is strained.

c. Anesthesia

Local anesthesia is used in general. Peribulbar anesthesia or subtenon injections to superior conjunctiva have been described. As such, optic nerve is protected against injury related to needle or drug. However, general anesthesia is warranted in children, young adults, patients with tremor, epileptic patients and patients with dementia[2]. In eyes with narrow angle, local anesthesia should be avoided as it will result in mass effect around the eye and increase risk of surgery; thus, general anesthesia should be used.

The eyelid opening achieved with eye speculum is sufficient for surgery. Since surgery is often performed at upper eye, the eye must be slightly deviated downwards. For this purpose, either a 5-0 non-traumatic bridle suture can be used in superior rectus muscle or a 6-0 monofilament intra-corneal suture through peripheral cornea can achieve deviation required. .

d. Trabeculectomy surgery

• Conjunctival incision can be made by two ways. In limbus-based incisions, the conjunctiva is lifted at anterior region of origin or superior rectus muscle using a forceps and an arc-shaped cut is performed to open conjunctiva together with tenon as conjunctiva being parallel to limbus (Figure 3). During conjunctival opening, undesired tear-hole formation over conjunctiva can be prevented by pushing episcleral tenon using sponges during conjunctival opening. Thus, sclera is exposed entirely. A slight cauterization is performed at the area where scleral flab will be hinged. Excessive burn should be avoided, which may lead tears or perforation of scleral cover after surgery. In addition, scleral cover is further thinner and undesired, uncontrolled blebs with excessive filtration can be seen since anti-fibrotic agents are also administered to this area. Conjunctival and scleral flaps should be uplifted with extreme caution and rough movements should be avoided in order to prevent rupture and penetration which can risk surgery.

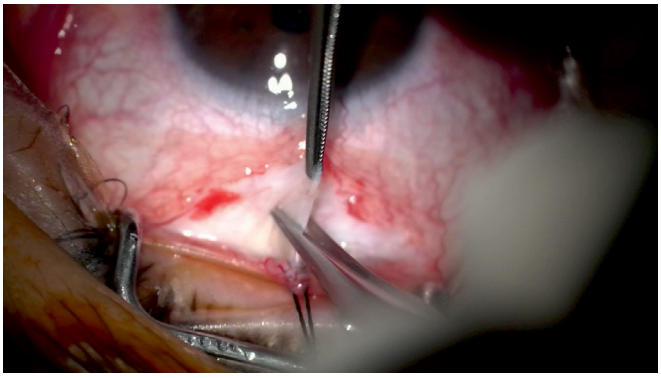

Figure 3: *Tenon is opened at the same line following limbus-based conjunctival opening. At the end of surgery, these tissues are sutured separately.*

Conjunctival opening can also be achieved by fornix-based incisions. The conjunctival opening is started at limbus as peritomy and dissected towards posterior to expose surgical site. In this method, the disadvantage is aqeuous leakage through limbus at early postoperative period which is not the case in limbus-based incisions. The advantage is that the technique allows more comfortable conjunctival opening in small eyes with smaller lid space hampering access to superior rectus muscle. In studies comparing both methods, no significant difference in surgical success at long-term.[2, 3].

• Anti-fibrotic-antimetabolite administration: The use of anti-fibrotic-anti-metabolit agents definitely improves surgical success and prolongs bleb lifespan[4, 5]. Mitomycin C (MMC) and 5-fluorouracil (5-FU) have long been used with proven efficacy. Although these agents were developed for use in disease other than ocular disorders, they are more commonly used by ophthalmologists today. In general, they are administered over sclera under conjunctiva-tenon cover either by directly or by sponges (Figure 4). 5-FU can be administered via subconjunctival route after surgery; however, it is difficult to adjust and control MMC dose in postoperative administration since MMC is 40- to 60-folds more potent than 5FU and may lead conjunctival and scleral necrosis. However, intraoperative episcleral administration is a simple and short procedure with excellent results at

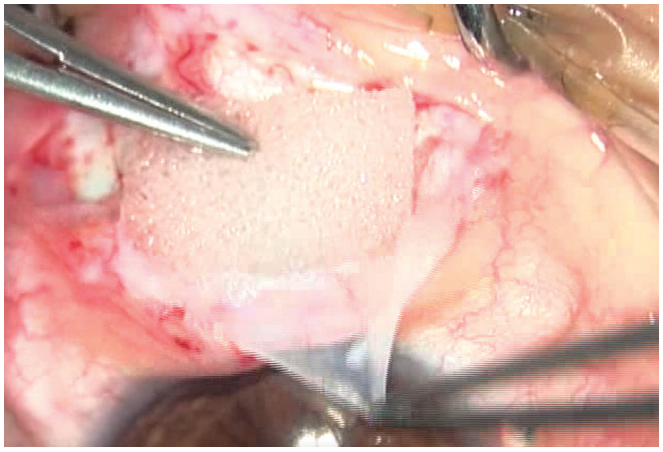

Figure 4: *Placement of a sponge soaked with 0.2 mg/ml MMC into the episcleral space*

appropriate doses. Thus, it is more commonly employed worldwide. 5-FU is administration without dilution while lyophilized MMC should be diluted before administration. For MMC, best result is achieved at a dose of 0.2 mg/ml given into episcleral space over 2 minutes[6]. At higher doses and longer duration, postoperative hypotonia is inevitable due to episcleral necrosis, bleb perforation and corpus corpus ciliare toxicity[6]. MMC is available as 2, 10 and 20 mg vials. Using 2 mg vial, MMC is prepared as follows: 10 ml of normal saline is transferred into a 10 cc injector. Then, 2-3 ml of normal saline is injected to MMC vial and vial is shaken. When MMC is dissolved completely, the fluid turns into blue. The whole blue fluid is transferred back into injector, resulting in 0.2 mg MMC per milliliter. Then, MMC is impregnated into thin gauzes.

Using 10 mg vial, MMC is prepared as follows: 5 ml of normal saline is transferred into a 10 cc injector. Then, 2-3 ml of normal saline is injected into vial and vial is shaken. When MMC is dissolved completely, the fluid turns into blue. The whole blue fluid is transferred back into injector. Now, there is 10 mg MMC in 5 ml normal saline in the injector. Four milliliter of MMC solution is drained away and resultant solution (1 ml) contains 2 mg MMC. Then, 9 ml of normal saline is added into injector and total of 10 ml solution is obtained. Final solution contains 0.2 mg MMC per milliliter. The solution prepared can be used for a few days if kept in cold and sterile manner. The administration of MMC widely over the area adjacent to surgical site, rather than surgical site alone, prolongs lifespan of bleb and minimizes cystic bleb formation[7].

• Preparation of scleral cover: The scleral cover (flap) is highly important to prevent hypotonia at early postoperative period and to protect eye in delayed bled endopthalmitis. Triangular, rectangular or trapezoidal flaps with base at limbus are prepared (based on surgeon's habits and sclera morphology (Figure 5). The size should be minimum 4x5 mm in rectangular flap and 5x5 mm in triangular flap since the window used beneath flap base will be around 3 mm; thus, at least 1 mm closure should be ensured at both sites when scleral cover is closed. The flap should be uplifted between episcleral-aqeuous veins, not over these veins, if possible in order to prevent bleeding while uplifting scleral flap. The thickness of flap should not be lower than 1/3 of scleral thickness but not exceed 1/2 of scleral thickness. Thin scleral flap may lead bothersome penetrations. In addition, as MMC is used in the surgery, scleral flap may become fibrillary and difficulties in suturing, resulting in severe hypotonia at postoperative period. Penetration in the flap warrant meticulous repair. In case of thicker flap, the scleral cover may obstruct filtration area; thus, suture removal may be required (YAG laser suturolysis, suture removal using needle).

The rupture in flap base may occur due to excessive retraction during surgery and it is frequently seen in thin flaps. It must be repaired cautiously since it leads hypotonia. If there is severe penetration or rupture and if repair is impossible, surgeon should abandon the site before performing penetration and surgery should be performed another site (Figure 6).

When preparing scleral flap, another important issue is not to discontinue lamellar dissection prematurely and to advance at least 1 mm within corneal gray lamella. Otherwise, trabecular meshwork may not be reached and iris root damage or bleeding may occur while penetration is performed. In case of buphthalmos, dissection should be further advanced towards cornea since there is abnormally forward insertion of iris and trabecular block should be

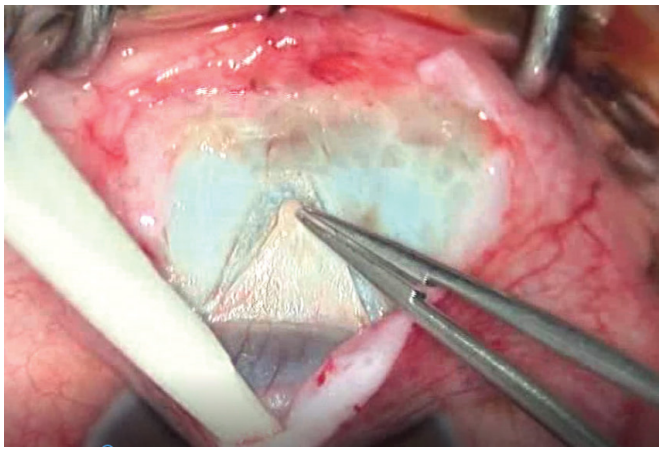

Figure 5: *Uplifting scleral flap with a thickness >1/3 thickness of sclera. In the case, triangular flap was used based on individual preference of surgeon.*

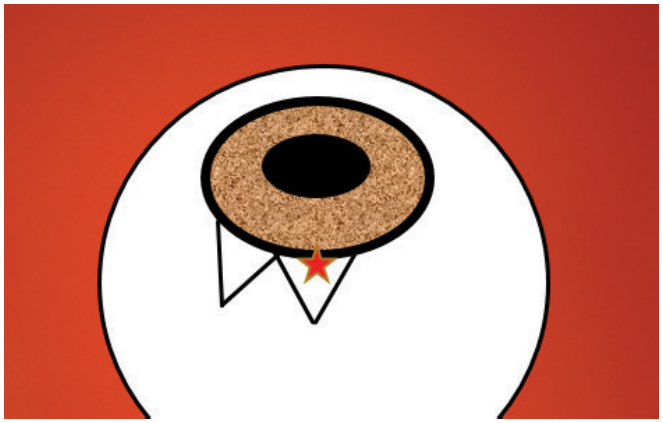

Figure 6: *As seen in the figure, the area should be abandoned and a novel site should be prepared if a hole is developed while uplifting scleral flap*

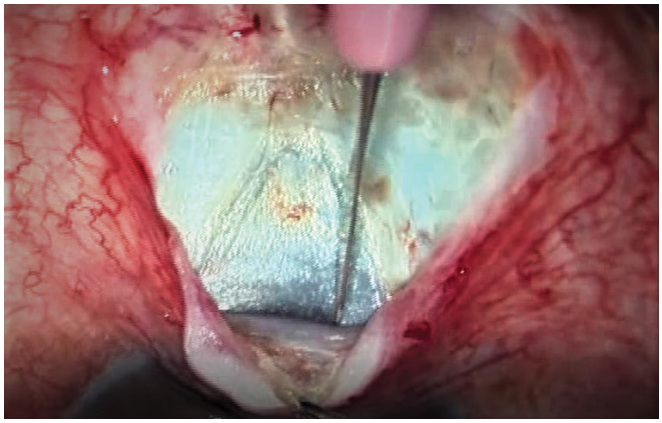

Figure 7: *Opening trabeculectomy window. The block is initially marked with 1 mm gap at lateral margins using surgical blades; then, the full-thickness block is removed using perpendicular dissection.*

removed more anteriorly. If trabecular meshwork is not reached is passed, vitreous losses occur in addition to iris trauma, which may lead early failure by blocking wound site. Same principle is also valid in neovascular glaucoma, aphakic glaucoma and uveitic glaucoma.

• Trabeculectomy: After exposing gray corneal band at the base of scleral flap, trabeculectomy penetration is performed. Just before this procedure, a paracenthesis is implemented at cornea while pressure is still high. This has two advantages: first, reducing IOP to modest levels by applying short and intermittent compression over the incision, such an IOP reduction prevents posterior segment complication resulting from sudden IOP decrease during trabeculectomy. Second, fluid is given into anterior chamber while scleral flap is closed using sutures and fluid leakage is observed through wound site in order to adjust sclera sutures.

When removing trabecular penetrating block, a block (1-1.5 x 3 mm in size) is removed by slow progressive dissection using surgical blades as being one-half of the block in gray cornea and the other one-half in white sclera) (Figure 7 and 8). At this point, thin scissors are also used. Lamellar dehiscence is not allowed. Otherwise, it can be failed to remove transparent Descement membrane since it cannot be removed and pressure elevations may be experienced as it blocks trabeculectomy window. This can be elucidated by gonioscopy at postoperative period. Surgical revision may be needed if penetration of the tissue using YAG laser (as similar to non-penetrating surgeries) is not beneficial.

During this procedure, surgical assistant should gently open scleral cover at 45° angle, not allowing its rupture. The assistant should not leave scleral flap during both trabeculectomy and subsequent peripheral iridectomy.

Some surgeons use trabecular punch rather than surgical

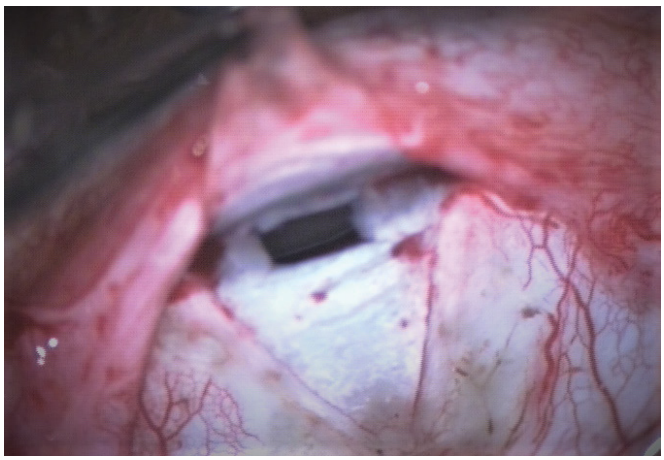

Figure 8: *Trabeculectomy and iridectomy were performed; eye is ready for closure.*

blade while performing trabeculectomy. In this technique, anterior margin of trabecular window is dissected and access to anterior chamber is achieved; punch is used to remove tissue from posterior aspect and a fistula is formed. If not performed at the accurate localization, it may lead iris root complications.

• Peripheral iridectomy: As soon as trabeculectomy is completed, peripheral iridectomy is performed. It is performed to prevent blockage of trabeculectomy area by iris root and to achieve patent HA efflux if pupillary block is developed due to any reason. As mentioned above, miotic agent used before surgery will cause miosis and provides more comfortable iridectomy. Iris root is engaged through trabeculectomy window; it is slightly pulled out and dissected, forming a triangular shape. The border adjacent to trabeculectomy window should be as long as length of the window (wide-based iridectomy: 2.5-3 mm in length).

Peripheral iris may be prolapsed through trabeculectomy window due to HA efflux caused by pressure in the anterior chamber and opening of trabeculectomy window, hindering surgical procedure. Persistent attempts to push iris back will lead iris trauma. If anterior chamber isn't shallow, fluid is discharged through paracenthesis; iris is pushed back thereafter or the swollen iris is ruptured by a needle or small scissor; HA is removed and reduction is achieved.

If iridectomy is small, trabecular window can be obstructed by iris root after surgery and IOP elevations occur. It can be established by slight retraction of pupil towards surgical site and failure to visualize iridectomy in biomicroscopy. In some cases, a miotic agent (pilocarpine) may recover iris root from the trabeculectomy site if it is recognized early. If it fails, iridectomy should be enlarged by surgical revision by surgical revision.

If not prepared appropriately, hemorrhage can be seen during iridectomy in neovascular glaucoma, uveitic glaucoma and traumatic glaucoma. In normal cases, bleeding may occur if iris root is grasped by advancing exceedingly posterior and iris vascular structures are dissected is dissected. Thus, one should not advance within iris root and only iris visualized through trabeculectomy window should be grasped and dissected. Most of the hemorrhages can be stopped by irrigation. In rare instances, postoperative hyphema may develop, requiring revision.

• Closure of scleral flap and conjunctiva: Following iridectomy, scleral flab is closed using 10-0 nylon sutures. The closure should be tight/lax enough to allow HA flow into episclera through space in the cover. Revisions are needed in sutures if they are very tight or lax.

In triangular flaps, 1 suture at apex and 2 sutures at lateral margins are generally adequate (Figure 9). In rectangular flaps, two sutures are initially placed at upper corners and lateral sutures are added based on fluid flow (Figure 10). Suture tips should be embedded into sclera in order to prevent conjunctival erosion by sutures over time. Thus, sutures should be very short. The sutures should be placed at a point at least 1 mm to corner of cover and sclera (overall 2-2..5 mm); thus, they can be grasped and embedded in a convenient manner.

After placing primary sutures, pressure is elevated by instilling fluid through clear corneal incision and fluid leakage should be observed by help of sponge under scleral cover (Figure 11). If sufficient fluid flow is confirmed by mildly drying with sponge, conjunctiva can be closed. If fluid flow is excessive and anterior chamber disappears

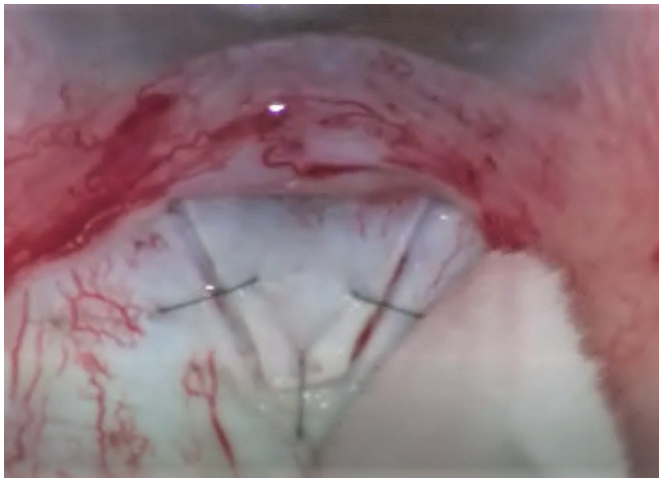

Figure 9: *Flap closed by 3 non-tight sutures and filtration control using sponge. In the control, a flap, which does not leak or leak excessively sufficient enough to empty anterior chamber, isn't desired. Modest leakage which does not empty anterior chamber over time is excellent.*

Figure 10: *A rectangular flap sutured at two corner. Leakage was optimized by adding 1 suture at lateral margin where leakage was excessive.*

spontaneously, it means there is excessive fluid flow; thus, sutures should be added at sites with excessive flow. Flow test is repeated and flow is observed, achieving intraoperative adjustment (Figure 12)[2, 3].

Some surgeons employ tighter sutures with adjustable-removable suture techniques or postoperatively adjust fluid flow using laser suturolysis. However, this may lead uncontrolled hypotonia.

Following observation adequate fluid flow, tenon tissues are faced with each other and tied using 3 to 4 single sutures and conjunctiva is closed using tight sutures (continued or single sutures) in order to confine HA leakage (Figure 13,

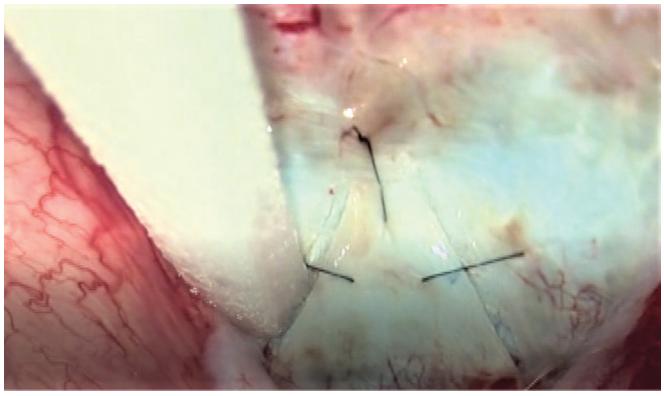

Figure 11: *Leakage test without compression wound using sponge after each suture.*

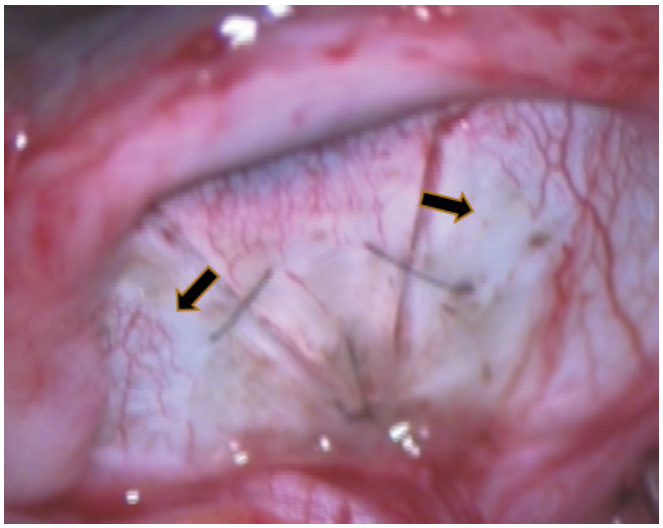

Figure 12: *Areas with HA leakage beneath flap.*

14, 15).

For closure, many glaucoma surgeons use 7-0 or 8-0 absorbable sutures. Traction sutures at cornea and superior rectus muscles are removed at the end of cornea; fluid leakage into and accumulation at subconjunctival area are observed. One drop of sterile cycloplegic agent is instilled into eye; cycloplegic agent is maintained at postoperative period (2-10 days). Since trabecular opening is large at early postoperative period, cycloplegic agents hamper excessive fluid flow in part, preventing shallow anterior chamber.

• Mini trabeculectomy: It is a modified trabeculectomy technique to minimize scarring at wound site. The aim and surgical principles are same. Conjunctival opening, scleral cover and trabecular window are smaller. After creating a small scleral tunnel, the window is created at trabecular area using punch. However, mini trabeculectomy is abandoned due to poor outcomes at long-term.

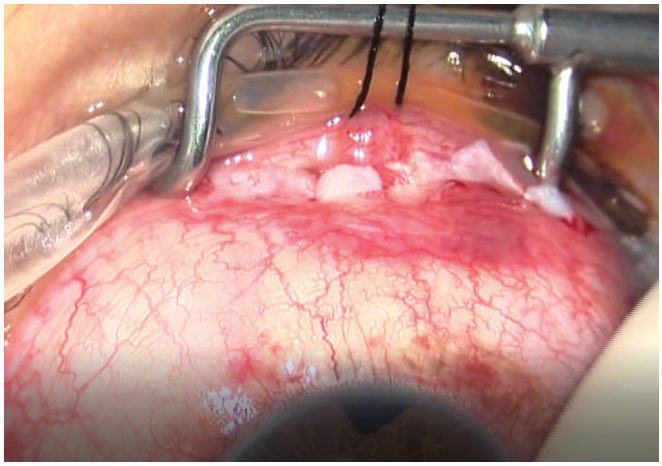

Figure 13: *Tenon - conjunctiva closure. Initially, tenon tissue is sutured using single absorbable sutures. This method is advantageous to minimize contribution of tenon to fibrosis development.*

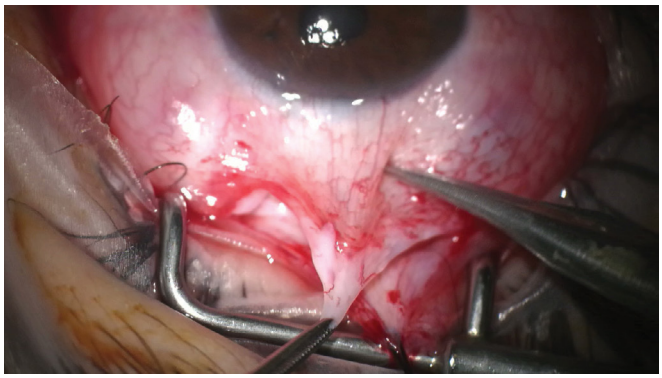

Figure 14: *At the end of tenon suturing, conjunctival margins are faced with each other. Conjunctiva is tightly closed using absorbable single or continued sutures.*

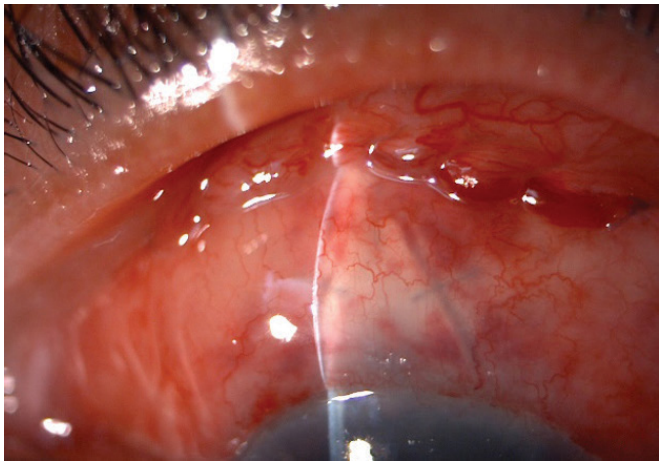

Figure 15: *Sealed conjunctiva closed using continued sutures; optimum HA leakage and non-swollen bleb on postoperative day 1. IOP, 9 mmHg; anterior chamber with normal depth.*

D. POSTOPERATIVE FOLLOW-UP AND PROBLEMS

1. Postoperative management

As mentioned above, to prevent excessive HA flow from trabeculectomy window and posterior synechia, topical cycloplegic agents are used 3 times daily for a period determined by clinician.

In general, topical antibiotic agents for a week and topical corticosteroids for 3-4 weeks provide sufficient antibacterial and anti-inflammatory control.

The patients should be instructed about not lying over his/her eye and not to close eye cover tightly. In the control visits on day 1, 3 and 7, the potential early problems can be monitored and surgical success can be improved by appropriate follow-up.

2. Early postoperative period

Ideal postoperative eye has an anterior chamber with normal depth, mild vascular paleness at bleb region (MMC effect), slightly swollen (shallow) bleb and swelling bleb with a mild compression over eye and lack of retinal hemorrhage and choroidal effusion in fundus examination (Figure 15 and 16).

If HA flow is inadequate and postoperative IOP is modestly elevated, HA flow can be enhanced by compressive massage at wound site. In these cases, anterior chamber depth is normal the dose of pressure and duration of massage are adjusted after observation of fluid flow in biomicroscopy and determination of wound stenosis. If bleb does not occur and IOP isn't decreased with pressure maneuver, massage is unnecessary. A revision must be made at early phase without further delay. A gonioscopy should be performed first and trabecular window must be observed. If trabecular window is patent, suturolysis is performed initially and lateral sutures are opened successively using YAG laser. After opening each suture, ocular massage should be performed to observe whether there is adequate flow and procedure should be ended or continued. If suturolysis fails, revision procedure is progressed and wound site is controlled by re-opening conjunctiva. The descement flaps, iris root and hemorrhagic debris obstructing wound site are removed and flap is closed by achieving better flow.

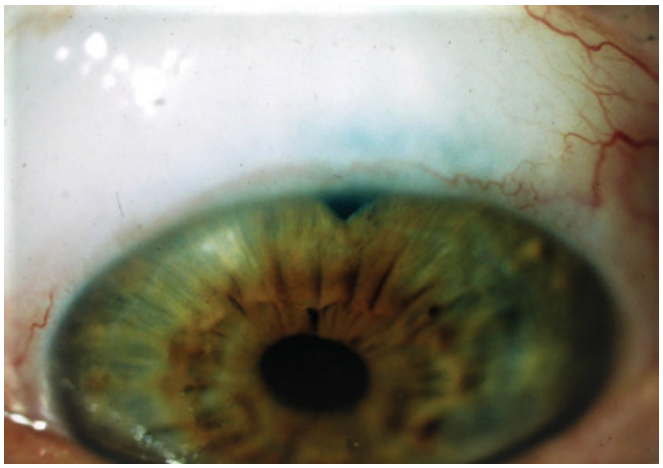

Figure 16: *Avascular, shallow, diffuse bleb at late postoperative period (after years).*

a. Postoperative swollen bleb, narrow anterior chamber, hypotonia:

If HA efflux is excessive, a highly swollen bleb, shallow anterior chamber and hypotonia are observed at early postoperative period. If there is complete loss of anterior chamber and there is a contact between iris and cornea, revision must be performed promptly. In these cases, there is scleral flap suturing and excessive HA drainage; the tap must be depressed[2, 3, 8].

If anterior chamber is partially shallow and there is no contact, it is attempted to reduce HA flow by cycloplegic agents for a few days, tight bandage, scleral contact lenses. However, fundus should be monitored continuously. If choroidal detachment due to hypotonia is started and progresses rapidly, a prompt decision for revision should be made. No intervention is required in case of early choroidal serous detachment, which rapidly recovers by reduction of hypotonia. However, in advanced cases (kissing choroid), choroid should be deflated by posterior sclerotomy and intravitreal air administration in addition to aqeuous revision. Conjunctiva is further opened posteriorly. At quadrant 1 and 2 where choroidal swelling is at highest level, scleral perforation is performed slightly posterior to equator using MVR blade or 30° blade; choroidal fluid is accessed when a yellow fluid flow is observed. To deflate choroid completely, a 5 cc injector with insulin needle attached which is filled by sterile air is inserted through pars plana and air is given slowly when posterior margin of lens is observed. Yellow fluid flow is observed at posterior aspect. When fluid flow is stopped, the procedure is discontinued. No scleral suture is needed.

b. Postoperative flat bleb narrow anterior chamber, elevated IOP:

These are findings of ciliary block glaucoma which is more commonly seen after surgery in cases with angle closure glaucoma and less commonly after filtering surgery in cases with open angle and pseudophakic eyes. In the severe complication, termed as malignant glaucoma

or misdirection glaucoma, HA is misdirected towards posterior segment instead of anterior chamber[2, 3, 8].

Prompt action is required. Intraocular pressure is elevated and not respond treatment. Pars plana is entered and vitrectomy is performed in attempt to correct misdirection. Irido-zonulo-hyaloidectomy is performed using vitrectomy probe in order to ensure flow towards anterior chamber and anterior chamber, posterior chamber and vitreal area are connected to each other with a virtual tube. In nanophthalmos cases, an extreme sample of narrow-angle glaucoma spectrum, the procedure should be performed after lens extraction during same surgery session.

KEY POINTS

• Trabeculectomy with its modifications is the most commonly performed glaucoma surgery.

• In advanced glaucoma and cases in which low pressure is desired, best result is achieved by trabeculectomy.

• Patient should be informed about results of surgery before operation. The aim of surgery, which is protecting available vision, should be emphasized repeatedly.

• Accurate use of agents suppressing fibrosis, namely mitomycin C and 5-FU, improves surgical success.

• Uncomplicated conjunctival opening and closure are very important for durability of wound site flap and protecting bleb against infections.

• Similarly, opening and closure of scleral cover is also important for bleb functionality.

• At early postoperative period, bleb, anterior chamber and fundus should be monitored closely.

• Early complications should be corrected early and timely in relentless manner.

REFERENCES

1. Cairns J. E. Trabeculectomy. Preliminary report of a new method. Am J Ophthalmol. 1968; 66: 673-9.

2. Glokom Kitap, SFN Tanıtım Tasarım Yayıncılık; 2003. Ed. M. Erol Turaçlı, M. Önol, I. S. Yalvaç.

3. Tüm yönleriyle glokom, Glo-Kat, 2016, Özel Sayı, ISSN 1305-9173; Ed. M. Önol.

4. Akarsu C, Önol M. Postoperative 5-fluorouracil versus intraoperative mitomycin C in high-risk glaucoma filtering surgery: extended follow up.; Clin Exp Ophthalmol. 2003;31:199-205.

5. Akarsu C, Önol M. Effects of thick Tenon's capsule on primary trabeculectomy with mitomycin-C. Acta Ophthalmologica Scandinavica 2003;81:237-41.

6. Sarı A., Önol M., Özdek Ş, et al. Effect of mitomycin C on ciliary body and intraocular pressure with various application depths: An experimental study. Clin Exp Ophthalmol 2005; 33:169-75.

7. Önol M, Aktaş Z, Hasanreisoğlu B. Enhancement of the success rate in trabeculectomy: large-area mitomycin-C application. Clin Experiment Ophthalmol. 2008;36:316-22.

8. Sarıcaoğlu MS, Glokomda filtran cerrahi sonrası kritik sorun: Bleb sızıntıları, Glo-Kat Dergisi, 2019; 14: 111-7.