Trabeculectomy! Indications, Techniques, Instrumentation, Wound modulation, Bleb management, Bleb evaluation, Complications. What you need to know!

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- Disclosure: Consultant for Alcon, Allergan
Indications for Trabeculectomy

- Primary open angle glaucoma
- Primary angle-closure glaucoma not responsive to iridotomy and/or iridoplasty
- Secondary open-angle glaucoma
- Secondary angle-closure glaucoma
- Childhood glaucomas
Contraindications for Trabeculectomy

- Cases that are likely to respond well to medical therapy or laser iridotomy.
- Eyes with previous failed trabeculectomy
- Eyes with severely scarred conjunctiva (e.g., chemical burns, Stevens-Johnson syndrome)
- Neovascular glaucoma with active neovascularization
- Uveitic glaucoma
- Blind eyes
Structural Loss Precedes Functional Vision Loss

- RNFL = retinal nerve fiber layer.
- Adapted from Weinreb RN. AGS 2002 lecture.
Rate-Based Change
Differing Rates in the Same Patient

MD slope: -1.84 dB/year

MD slope: -3.64 dB/year

Courtesy of Remo Susanna Jr, MD.
AGIS 7, associated analysis
Sustained IOP reduction below 18 mmHg is correlated with stability of visual field

Percent of Visits with IOP Less Than 18 mmHg

MEAN IOP
20.2 mmHg
16.9 mmHg
14.7 mmHg
12.3 mmHg

Medical Management vs Surgery
Both Stabilize Visual Fields

Collaborative Initial Glaucoma Treatment Study (CIGTS)


1- (reference IOP + VF score)/100 x Reference IOP = 40% reduction
Non Compliance With Antiglaucoma Treatment

- Communication
  - More than 40% of pts being treated with glaucoma do not realize it can lead to blindness
    GRF survey
- Non-compliance can be as high as 50% for one med, 61% for two meds, 70% for multiple meds

Patel, Spaeth: Compliance in patients taking eyedrops for glaucoma: Ophthalmic Surg 1995 26 ;3 ;233-236
Laser trabeculoplasty is not as effective in patients on combination medical therapy and short lived.
Risk factors for Progression in Advanced Glaucoma

<table>
<thead>
<tr>
<th>Ocular risk factors and signs</th>
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<tr>
<td>Strong evidence</td>
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<td>Advanced structural and/or functional (VF) loss at initial presentation</td>
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<td>High or marked visit to visit IOP fluctuation</td>
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<td>Exfoliation syndrome</td>
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<td>Moderate strength</td>
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<td>Poor compliance</td>
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<td>African race</td>
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<td>Increasing age (POAG) or very young age (JOAG)</td>
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<td>Strong family history of blindness</td>
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<tr>
<td>Decreased ocular perfusion pressure (diastolic BP - IOP = &lt;55 mm Hg)</td>
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<td>Socio-economic background, poor compliance</td>
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VF: Visual field, IOP: Intraocular pressure, POAG: Primary open angle glaucoma, JOAG: Juvenile Open Angle Glaucoma, BP: Blood Pressure
Trabeculectomy is the Gold Standard Surgery for Glaucoma!
Outcomes Disparities between Black and White Populations in the Surgical Management of Glaucoma.

- “At this time, there is no strong evidence that any procedure is more effective for intraocular pressure control than standard trabeculectomy for Black patients”.

- There is also a need for data on the efficacy of minimally invasive glaucoma surgery (MIGS) in Black populations.
Instruments needed

- Straight Tying Forceps,
- Mcpherson Tying Forceps,
- Bishop-Harmon Tissue Forceps,
- Kelly Punch,
- Suturing Forceps,
- Hartmann Curved
  - Hemostatic Mosquito Forceps
- Barraquer Iris Scissors
- Castroviejo Needle Holder,
- Westcott Tenotomy Scissors
- Vannas Scissors
- Lieberman Speculum,
- Castroviejo Caliper,
- 10 suture, 8-0 vicryl, Crescent blade
- 59 blade, 15 blade
Pre-operative Preparation

- The risks of surgery must be explained to the patient in advance.
- In particular, it is vital to explain that surgery for glaucoma is usually done to preserve vision and will likely not improve vision (unless combined with cataract extraction).
- Several studies have demonstrated a loss of best-corrected visual acuity (of about 1 line) in post-operative patients, and it is essential that patients are aware of this.
Intraoperative Pearls

- Use a betadine prep to sterilize the eye and eyelashes to prevent endophthalmitis
- Ensure pt does not have pre-existing meibomitis
- Lidocaine gel on the conjunctiva for topical cases
- Ensure the eye is pre-treated with Pilocarpine 2% to prevent iris incarceration during the trabeculectomy and after iridectomy
Fornix-Based
Trabeculectomy
Combined with Cataract Surgery
Ideal bleb with mild vascularity
Consider Combined Trabeculectomy Surgery with Cataract

- This avoids pressure spikes post operatively can maintain long-term IOP control.
- This can and will often reduce the financial burden by eliminating or reducing medications.
Avoid Honan Balloon
Pre-operative Preparation

- Continuous orbital compression with balloons and other devices should be avoided as they can raise intraocular and intraorbital pressure considerably, with attendant risks of nerve and/or vascular compromise.

- The optimal anesthetic route in patients with advanced glaucoma for patients who are cooperative, is topical/subtenons, which is as effective as retrobulbar anesthesia.
Pre-operative Preparation

- For patients who are extremely anxious or uncooperative (e.g., young age), peribulbar anesthesia with sedation, or general anesthesia may be required.

- The IOP needs to be lowered slowly intra-operatively in order to avoid a catastrophic suprachoroidal hemorrhage or to setup a cycle of aqueous misdirection in predisposed eyes.

- Pre-operative mannitol (0.5 mg/kg) or acetazolamide (po or iv) can be helpful in this regard. If the IOP is still high immediately pre-operatively, the eye can be decompressed slowly via a paracentesis.
Conjunctival flap

Two types of conjunctival flap:

- **Limbal based conjunctiva flap (LBCF)** – incision deep in fornix with base at limbus

- **Fornix based conjunctival flap (FBCF)** – incision at limbus with base at fornix
Many surgeons still argue that the limbus-based approach during trabeculectomy is better because patients are less likely to get a wound leak,

But when you have a limbus-based flap, you’re making this incision posteriorly, and that incision will contract and form a limiting scar and may lead to blebs becoming very small and cystic as opposed to a fornix based flap where you don’t have that posterior incision.
Cystic blebs are more prone to leaking, which could lead to infections, hypotony, and other complications.

Limbus-based flaps also are more difficult to make than fornix-based flaps.
Fornixed Based Suturing Tips

- At the end of the case, suture the fornix-based flap back to the conjunctiva.
- Take bites of Tenon’s layer as well to form a tighter seal.
- Can also use a running horizontal mattress suture using 10-0 Vicryl, on a vascular needle (D-7329) (Ethicon Inc., a division of Johnson & Johnson, New Brunswick, N.J.).
- This is designed so that the needle track is no greater than the suture diameter so that leaking doesn’t occur from the suture.
Wound Modulation

5-Fluourouracil

- Fluorinated pyrimidine analogue
- Interferes with the synthesis of thymidine nucleotides
- Inhibits DNA synthesis
- Targets Fibroblasts
- Usually multiple postoperative injection
- Intraoperative application
- Corneal epithelial toxicity, Conjunctival erythema, Uveitis
- Less potent, less durable, less complications

Mitomycin C

- Antibiotic agent derived from the soil fungus *Streptomyces caespitosus*
- Cross-links DNA
- Inhibits protein synthesis
- Targets both Fibroblasts and Endothelial cells
- Single intraoperative application
- Scleritis
- Scleromalacia
- Corneal endothelial cell loss
- More potent, more durable, more complications
Delivering the anti-fibrotic agent

- Cellulose sponge ~5 × 3 mm soaked in antimetabolite is placed under dissected tenon’s capsule for 3-5 mins before paracentesis of AC followed by thorough irrigation with BSS.
Mitomycin Injection

- In order to inject mitomycin-C in trabeculectomy surgery safely, it is important to pay attention to your dosages.
- The dose we use is more dilute than that used when applying mitomycin-C with the sponge method.
- With a sponge, surgeons generally use 0.1 mg/ml to 0.4 mg/ml of mitomycin-C, but when injecting it, a lower concentration of 0.05 to 0.1 mg/ml is used because of the direct injection into Tenon’s layer.
Releasable sutures

- Preferred when Scleral flap sutures can be obscured by subconjunctival hemorrhage, thickened tenon’s capsule or fibrosis
- First originated from Shaffer et al (1971)
- Simple, low-cost and efficacious
Post-operative Care

- Typical post-operative medications include antibiotics and corticosteroid eye drops.

- The type, strength and frequency of administration are dictated by the degree of inflammation, presence/absence of complications, and amount of filtration (function of the bleb).

- Cycloplegic eye drops (like atropine) may be administered at the conclusion of surgery in phakic patients, particularly if there is anticipation of shallow AC and/or instituted post-operatively, in the presence of significant inflammation or shallow AC.

- Intracameral preservative free vigamox 2cc diluted with bss can be given to help prevent infection.

- Subconjunctival Kenalog 4mg/ml, .2cc can be given to ensure immediately anti-inflammatory action begins.
Post-operative Care

- Pred Forte q 2hours, Ocuflox Qid for at least 1 week
- See patient post-op day 1 to ensure they have medications and use them properly
- Eye shield at night for the first week
- Protective glasses during the day to prevent accidental trauma
- Inform patient not to press on eye at ALL
Post-operative Care

- See patient post-operative day 7 or 14 depending how patient looks and if feeling.
- If IOP drifts higher at day 14 can remove 1 releasable suture or perform laser suture lysis
- If no IOP decrease can consider a second suture lysis.
- If no response can consider transconjunctival needle revision to rescue the bleb.
- See patient Post-op day 21.
- By this time wing suture can be removed.
- If all sutures are out discontinue antibiotic and can start to taper pred forte to qid for 1 week, tid for 1 week, bid for 1 week, then qd for 1 week.
Post-operative Care

- See patient post-operative day 42 (6 weeks)
- By this time the IOP may be at target, if so DC steroids and see pt in 3 months for f/u.
- If IOP is above target add a medication and re-evaluate in 2 weeks
- If IOP is severely above target add multiple medications and re-evaluate in two weeks
- If IOP is not adequately controlled consider Needling, Bleb Glaucoma tube shunt surgery
Fixed sutures and laser suture lysis

- Laser suture lysis introduced by **Lieberman (1983)** using argon laser
- Facilitated by compressing overlying conjunctiva to visualize scleral suture or high magnification suture lysis contact lens (Hoskins or Blumenthal lens)
- Argon laser: 50µm, 0.1 sec duration, 250-1000 mW power
- Within first 3 weeks: enhance filtration before scarring occurs
- Delayed (up to 8 weeks) if intraoperative antimetabolite used
Laser suture lysis can use a Zeiss 4 mirror lens.
Adjustable sutures

- Allows trans-conjunctival adjustment of tension post-operatively for gradual titration of IOP using specially designed forceps with blunt tip

Khaw adjustable suture forcep
Bleb Needling

• 25G needle (sturdier)
• 5 to 10 mm temporal from the bleb site
• Posteriorly directed, bevel up, tangential to sclera
• Advanced in the bleb with a twisting motion
• Subconjunctival fibrosis cut with firm back & forth, side to side motions till eye softens
• Can enter AC (pseudophakes; flat bleb)
• Avoid conjunctival buttonhole
Bleb Needling Video
Complications of Trabeculectomy

- Reasons for decreased vision include:
  - cataract, hypotony maculopathy, suprachoroidal or vitreous hemorrhage, retinal detachment, optic nerve damage, and uncontrolled IOP.

- Identification of high risk groups for complications and careful anticipatory planning can prevent some complications.

- However, loss of central vision can occur even after an otherwise uncomplicated operation, and this has been termed the “wipe-out” phenomenon.
Anesthesia related complications

- Acute retrobulbar hemorrhage presents as proptosis associated with hardening of the eye, discoloration of lids and subconjunctival hemorrhage following local anesthetic injection.
- Elevated intraocular pressure (IOP) that occurs with retrobulbar hemorrhage can compromise blood flow to the optic nerve in advanced glaucoma.
- In this situation immediate measures include intravenous administration of mannitol (1 g/kg body weight of 20% solution) and lateral canthotomy with lateral cantholysis.
- Surgery should be deferred till the complete absorption of hemorrhage
Complication of antimetabolites

- Corneal epithelial defects
- Post-operative wound leaks
- Cystic thin walled bleb: Chronic hypotony, late-onset bleb leak, endophthalmitis
Scleral flap difficulty

Scleral flap damage: tearing and buttonholing

- Avoid thin flap and excessive manipulation
- Avoid flap amputation
- If a large problem start at another location or change to tube shunt

If a small problem:

- Minor damage - repair
- Severe damage - autologous or donor sclera patch
Avoid Conjunctival button holes

- Stromal hydration- BSS injected under conunctiva/tenon to make them thicker
- Blunt dissection
- It is of utmost importance to handle the conjunctiva gently using non-toothed forceps.
- The risk of inadvertent buttonholes is greatest in previously operated eyes that have extensive subconjunctival scarring.
- Efforts must be taken to avoid the cut edges of the conjunctiva touching the antifibrotic agent used.
- Direct repair of the buttonhole can be performed using a purse-string suture or single or multiple mattress sutures using a 10-0 Nylon suture on an atraumatic needle.
- All the conjunctival leaks should be closed before concluding the surgery.
Tear or Button Hole Repair

Management:

- Running locking suture technique,
- Large holes-
Purse string vicryl suture
Avoid Blood Thinners

Pre-op

Hemorrhage should be minimized as blood is a potent stimulus for fibrosis.

Risk factors:
- Long term anti-glaucoma medication
- Aspirin, anti-coagulants

Management:
- Wet field diathermy
- Gentle sustained pressure over fistula or bleeder vessel
- Large air bubble or viscoelastic in AC
Intraoperative Bleeding

- During iridectomy or inner block removal injury to the major arterial circle of iris can cause bleeding.
- Irrigation or application of pressure stops the bleeding.
- If the bleeding persists one may have to close the flap and increase the IOP to stop the bleeding.
- Small hyphemas are usually self-limiting. Larger hyphemas require drainage via an AC paracentesis.
Suprachoroidal hemorrhage

- The risk factors for this include aphakia, vitrectomized eyes, congenital glaucoma, pathological myopia, patients on anticoagulants and significant hypotony.

- Strong association of SCH with higher preoperative IOP and longer axial length has been reported.

- Preventive measures in high-risk groups include IOP reduction by medications including hyperosmotic agents and releasing aqueous gradually through the paracentesis tract.

- Preplacing scleral flap sutures facilitates closure of the scleral flap without resulting in significant duration of hypotony.
Decompression retinopathy

- Retinal hemorrhage following rapid IOP reduction

Vitreous loss

- Inadvertent damage to lens/zonule complex during PI
  - Keep the eye formed
  - May need to do anterior vitrectomy to remove vitreous prolapse.

Prevention:

- Anterior sclerostomy
- Consider Tube surgery in iridolenticular instability
Post operative complications

1) Hypotony and shallow anterior chamber
2) Hypotony and deep anterior chamber
3) Elevated intraocular pressure and flat anterior chamber
4) Elevated intraocular pressure and deep anterior chamber
Hypotony with flat anterior chamber

A. Negative seidel test with grade I or II flat AC with hypotony with a formed bleb- Scleral flap leak, overfiltration.

Management:

- Conservative: Topical steroids and long acting cycloplegic
- Restricted activity and avoid Valsalva
- Pressure patch of filtration site
Pressure patch technique
Hypotony with flat anterior chamber

Excessive filtration:

- Loose scleral flap closure or large filtering bleb (anti-fibrotic)
  - Large soft contact lens
  - Symblepheron ring
  - Simmons shell
  - Surgical: Viscoelastics, BSS,
  - 15% perfluoropropane(C3F8),
  - 40% sulfur hexa fluoride(SF6)
Hypotony with flat anterior chamber

- Positive Seidel test with grade I flat anterior chamber and low intraocular pressure- small leaks around sutures
  - Increased frequency of topical antibiotics
  - Pressure patching
  - Therapeutic contact lens
  - Fibrin tissue glue or cyanoacrylate glue
  - Simmons shell
Hypotony with flat anterior chamber:
Serous choroidal detachment

Mechanism:
- Pressure differential in hyotonic eyes causes fluid with small and medium sized proteins to diffuse from choroidal capillaries to extravascular space
- Prolongs hypotony by reduced aqueous production and increased uveoscleral outflow
- Treat with cycloplegic agents and steroids
Choroidal detachment

- Catagorized as serous or hemorrhagic.
- Serous choroidal detachments will often resolve with conservative management.
- Choroidal detachments are approached surgically if they are appositional or if they are large and do not demonstrate resolution with conservative management.

Choroidal Drainage Using 25 Gauge Instrumentation

by John W. Kitchens, M.D.
Hypotony with deep anterior chamber:

- A lower-than-normal IOP in first 2 weeks with no associated complication may resolve spontaneously
- Persistent hypotony (<6mmHg):
  - Hypotony Maculopathy
  - Fine macular striae radiating from fovea
  - Extensive choroidal folds
  - Tortuous retinal vessels
  - Disc edema
  - No evidence of vascular leak
Hypotony

- Autologous blood injection and surgical revision of the bleb (resuture of the scleral flap, or scleral patch graft) appear to be more effective when treating late onset hypotony.

- May need to bring back to operating room to tighten scleral flap sutures
Compression suture for large blebs, overfiltration or hypotony.
Elevated IOP with flat anterior chamber

a) Aqueous misdirection syndrome (malignant glaucoma)

b) Delayed suprachoroidal hemorrhage

c) An incomplete iridectomy with pupillary block glaucoma - patency should be established immediately on diagnosis by laser or, if necessary, incisional surgery
Malignant Glaucoma
Management

Atropine and topical steroids

- Aqueous suppressants: Brimonidine, Timolol, CAI’s, IV mannitol

- Surgical intervention: waiting period of 5 days advised
  - Nd-Yag laser- pupillary block, retrocapsular block or hyaloid block
  - Anterior vitrectomy, iridozonular hyaloidectomy, Pars plana vitreous aspiration or Pars plana vitrectomy
  - Cyclodiode photocoagulation (refractory cases)
High IOP Deep Anterior Chamber

- Perform gonioscopy if needed to rule out the obstruction to flow at the sclerotomy site.
- Obstruction is rare and is usually due to fibrin, blood, vitreous, iris or imperforate Descemet’s membrane.
- The obstruction with fibrin and blood is transient, whereas obstruction with iris or vitreous needs intervention.
- Tight flap closure is the common cause for raised IOP with deep AC. The goal of management here is to separate the edges of the scleral flap with digital pressure or massage.
- The IOP, depth of the AC and height of bleb should be noted after the digital pressure. These measures may have to be repeated multiple times.
Another important cause for elevated IOP with a deep AC is bleb encapsulation.

It is also referred to as Tenon’s cyst and it usually occurs during the second to fourth postoperative week as a tense, “tight-appearing” bleb.

The bleb is firm with few or no microcysts.

The IOP tends to rise with encapsulation but falls after two to four months. Temporary IOP reduction with medications such as aqueous suppressants is usually required.

Bleb needling with antimetabolites is an option in case of sustained raised IOP. Failing all measures, a surgical bleb revision (partial/complete cyst excision) or trabeculectomy may be required, especially in cases of multiloculated cysts.
Bleb manipulation techniques

Bleb massage

- Digital pressure through upper lid as posterior as possible to scleral flap under direct slit lamp visualization
- Steady pressure with index finger to inferior sclera through lower lid for 15 seconds
- May be repeated several times over first few weeks if needed
Bleb Massage, Suture lysis, Needling
Other early post-operative complications

- Uveitis
- Hyphema
- Dellen: Adjacent to large filtering bleb
- Loss of central vision:

  “Snuff-out syndrome”- common in old age, hypotony, macular splitting (visual field loss within 10° of fixation)
Late post operative complication

b) Leaking filtering bleb

- Thin walled large avascular blebs are at risk
- Use of adjunctive anti-metabolite

Management:
- Cyanoacrylate glue, autologous fibrin, large BCL
- Bleb revision: New conjunctival flap or rotational conjunctival flap
Blebitis

- White bleb with surrounding intense conjunctival injection
- Variable anterior chamber reaction
- Clear vitreous
- Risk factors:
  - Early chronic intermittent bleb leak
  - Myopia: thin scleral flap
  - Intra-operative MMC
  - Blepharitis
  - Diabetes mellitus
  - Chronic antibiotic use

Treatment: Topical antibiotics
Other late post operative complications

- Development and progression of cataracts
- Spontaneous hyphema
- Hypotony and ciliochoroidal detachment
- Rare: Sympathetic ophthalmia
Side effects requiring lubrication

Corneal dellen adjacent to bleb, leads to pain, tearing.

Large bleb causing irritation, interferes with blinking, leads to dry eye, treat with lubrication.
Low IOP without Filtering Bleb

Flat bleb

Supraciliary effusion
Late Hypotony can sometimes be treated with cataract surgery.

- Phacoemulsification surgery may be associated with a statistically significant elevation in IOP in previously filtered eyes with hypotony, resulting in resolution of hypotony in some of these challenging cases (Doyle, Arch Ophthalmol. 2000;118:763-765).
Repair of hypotony with pericardial patch
Management of leaks

- Conjunctival advancement was successful in closing late-onset bleb leaks in 24 (92%) of the 26 patients.
Repair of Bleb Leak
To be a good surgeon it is important to know how to manage complications when they occur.
Summary

- The more advanced the glaucoma, the lower target IOP
- Consider earlier surgery in the hands of experienced surgeon for advanced disease and high pressure fluctuation
- Use excellent equipment, technique, for surgery.
- Managing the post-operative patient is crucial to success
- Learn how the manage complications
Thank you!