Surgical options in glaucoma

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Disclosures

- Principal investigator for iVue OCT trial
- Principal investigator Topcon FDA trial for Maestro and OCT 2000
- Consultant for Optovue and Topcon
- Speakers bureau Sanofi- Genzyme and Allergan

Outline

- A) Decision making involving choosing medical and surgery as the modality of treatment in managing glaucoma
- B) Types of drugs and groups and efficacy.
- C) Types of surgery
  - Laser
  - Trabeculaectomy
  - Minimally penetrating glaucoma surgery
  - Drainage devices

To chop or to drop

- This debate has gone on for long time
- What should occur first?
  - Drop
  - Chop

Medications first advantages

- Drugs are safer than surgery-
  - Less complications
  - Less discomfort
- Drug effects can reversed or is short acting
- Less expensive in the short run
- Multiple drugs can be combined to achieve successful reduction in IOP
- Better quality of life when compared to surgery first (Lichter et al., Ophthalmology 2001)

Medications first disadvantages

- May be more expensive in the long run
- Multiple drugs
  - Compliance, adherence and persistence issues
- Chronic drug uses and its effect on future surgical outcomes?
  - Preservatives effect?
  - Inflammation leading to failure of future procedures*
- Increased chances of cataract formation

- *Broadway DC et al., Adverse effects of topical antiglaucoma medications: II Arch Ophthalmol 1994

Surgery first - advantages

- If successful and large drop in IOP may be obtained
- No issues related to patient compliance, adherence and persistence
- Good in situations where obtaining continuous supply of medications is a problem
- May be cheaper long term

Surgery first - disadvantages

- Outcomes may be variable
- Long term may loose efficacy
- May still require additional topical medications
- Complications may be dire
- Comfort and quality of life may be lower
- Chances of cataract formation is greater than topical medications
- Age- young vs. older individuals

Race and management options

- Race – white versus individuals with greater pigment
- Individuals with greater pigment- greater risk of pos-operative scarring*
  - Medications –first choice
- *Broadway DC et al., Racial differences in the results of glaucoma filtration surgery: are racial differences in conjunctival cell profile important? BJO 1994

Age and management options

- Younger individuals
  - Accelerated wound healing systems
  - Thick fleshy periocular tissues heals rapidly
- Thus older individuals better suited for surgical options

Overall mostly it is medications first!

When is surgery indicated?

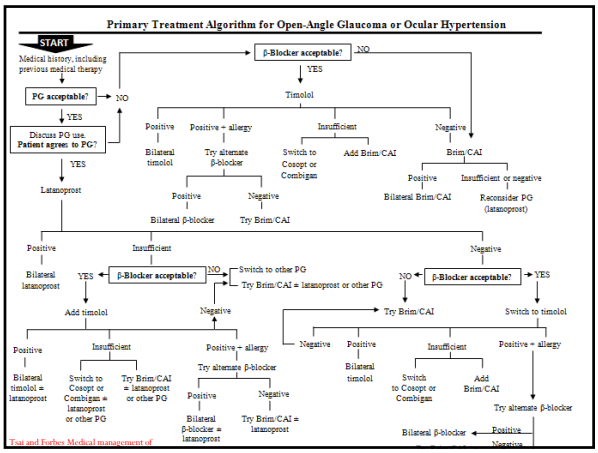
Current practice patterns

- Unacceptable high pressures will inevitably destroy optic nerve tissue
- Safe levels of IOP by any means warranted
  - If these don't work or not sufficient
  - drugs like – prostaglandins
  - reduction in inflow – beta blockers
- Maximal medical therapy
- Consider surgery

Maximal tolerated medical therapy

- *β-Blockers*
- Timolol
- Betaxolol
- Levobunolol
- Carteolol
- Metipranolol
- *Carbonic Anhydrase Inhibitors (CAIs)*
- Systemic:
  - Acetazolamide
  - Methazolamide
- Topical:
  - Dorzolamide
  - Brinzolamide
- *Adrenergic Agonists*
- Nonspecific:
  - Dipivefrin (epinephrine) – also increases conventional outflow
- α_2-Agonists:
  - Brimonidine – also increases uveoscleral outflow
  - Apraclonidine – also increases uveoscleral outflow
- *Conventional/Trabecular*
- Cholinergic agonists (parasymphathomimetics):
  - Pilocarpine
  - Echothiophate iodide
  - Carbachol
- Prostaglandin derivatives:
  - Bimatoprost
  - Latanoprost
- Nonspecific adrenergic agonists:
  - Dipivefrin (epinephrine)
- *Nonconventional/Uveoscleral*
- Prostoglandin derivatives:
  - Latanoprost
  - Bimatoprost
  - Travoprost
- α_2-Agonists:
  - Brimonidine

And how exactly do I use them?



Do we really have the luxury to use them all?

- Stage of disease
  - Visual field status
- Stage of nerve damage
  - Rim tissue remaining
- Type of glaucoma
  - POAG – medical first makes sense
  - Secondary glaucoma
  - Congenital glaucoma
  - Complete angle closure

  } treated differently
- Adherence, compliance, persistence issues
- Effect of medications and future outcomes of surgery

Laser Therapy

Argon Laser Trabeculoplasty- (ALT) theory

- Enhances aqueous outflow
- How does it cause increase outflow
- Exact mechanism unknown
  - Mechanical theory
    - Mechanical tightening of trabecular meshwork
      - Opens adjacent untreated spaces
  - Laser induced cellular changes
    - Microphages migrate to the location
      - Clears trabecular debri

Argon Laser Trabeculoplasty- indications

- Open angle
- Require decrease in IOP
- Both POAG and secondary like pseudoexfoliation or pigmentary

- Poor candidates
  - Angle recession, uveitic glacuoma, aphakia, high IOP (35 or greater), high episcleral venous pressure
  - Very young individuals
  - Previous 360 degree ALT

Preoperative considerations

- Depends on status of disease
- Continue IOP lowering medications (if on it)
- If moderate loss or damage
  - Preoperative 1% apraclonidine or hyperosmotic agent

- Best performed undilated
  - Does not require pupil constriction either

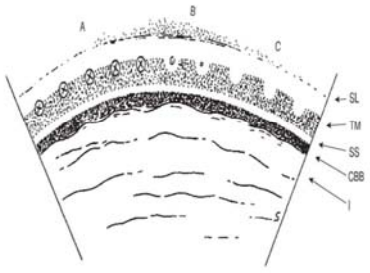
Procedure of ALT

- Anesthetic and goniolens with coupling fluid
- Clear view is a must
- Ideal lens Ritch lens (good view, optics most suitable and least collateral damage)
- Recommended spot size is 50 micro meter and 0.1 second duration
- Power 0.5 W to1.0 W
- Ideally tissue should blanch or small bubble should form

Procedure of ALT cont...2

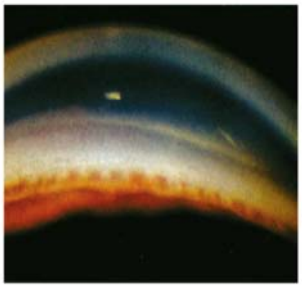
- Eight (8) burns per clock hour
- Location of burn- junction of non-pigmented and pigmented meshwork
- 50 burns per session (two sittings ideal)
- or 100 burns per 360 degrees of meshwork (that is total)

Placement laser burns



Shields textbook of glaucoma

Blanched lesions after ALT



Post-operative management

- Remain in office for 1 hour at least
- Monitor IOP
- 1% apraclonidine immediately after procedure
- Topical CAI or pilocarpine may be considered or oral hyperosmotic agents
- Steroid use for 4 days
  - Prednisolone acetate 1% 4 times a day for 4 days
- Continue IOP lowering medications if already on it
- Follow-up schedule 1,4 and 8 weeks (approx 2 months)

Outcome

- If IOP still high
- Consider doing other 180 degree if option (4 weeks later)

Summary of Argon Laser Trabeculoplasty

- Laser burns to trabecular meshwork
- Enhances aqueous flow and thus lowers IOP
- Usually an adjunct therapy
- Treatment benefit seen 4-6 weeks
- 180 degrees at a time, 360 can be done
- Retreatment not effective

Results of ALT

- POAG success rate 75-80%
  - Average reduction in IOP reduction is 30%
- 50% still controlled after 5 years
- Failure if occurred usually first year

- NTG success rate 50-70%
  - Absolute reduction in pressure not as good as POAG
- Pseudoexfoliation glaucoma
  - Excellent results
  - Not as good in other secondary glaucoma
  - Does not work in pediatric glaucoma

Selective Laser Trabeculoplasty (SLT)

ALT versus SLT

- Unlike ALT SLT does not scar
- Autopsy specimens – confirm no coagulative damage after SLT
- Ultrastructural measurements show
  - Crackling of intracytoplasmic pigment granules
  - Disruption of trabecular endothelial cells
- In-vitro studies pulsed laser
  - longer than 1 microsecond –non selective damage of pigmented cells
  - 10 nanosecond to <1 microsecond – no collateral damage

Mechanisms of action SLT

- 5-8 fold increase in monocytes and macrophages in TM
  - after treatment with SLT
- Hypothesis
  - Injury via laser causes releasing of chemoattractant
  - This in turn recruits monocytes that are transformed into macrophages
  - Macrophages clear pigment granules and exit via Schlemm's canal

Alvardo and Murphy Outflow obstruction in pigmentary and primary open angle glaucoma Arch Ophthalmol 1992

Pre-operative considerations

- Alpha 2 agonists preoperative (Brimonidine or Apraclonidine)
  - Helps reduce post-operative spikes
- Untreated eyes- timolol may also work
- Topical anesthetic before procedure

SLT -procedure

- Frequency doubled Q-switched Nd:YAG laser
  - 532 nm
  - Pulse 3 nanosecond
  - Spot size 400 micro meter
- Beam focused over pigmented TM
- Standard therapy 50-100 adjacent non-overlapping spots over 180-360 degrees
- Power 0.8mJ (0.2 to 1.7mJ)
- Heavily pigmented eyes – lower power
- Endpoint- tiny "champagne" bubbles

Selective Laser trabeculoplasty

- Selectively targets melanin pigment of TM
- More safe compared to ALT (because lower power)
- Equally effective as ALT
- Can be repeated if first attempt is not effective

Post-operative considerations

- Anti-inflammatory medications –post SLT prophylaxis
  - NSAID or steroids
  - Does not give added benefit in lowering IOP
- No robust evidence in suggesting use or not to use anti-inflammatory agents post SLT

Video SLT

Video SLT heavy pigmentation

Peripheral iridotomy

Angle closure glaucoma

Indications

- Acute primary angle closure
  - One to two days after attack
  - Once eye is settled and edema is cleared
- Fellow eye of acute primary angle closure
  - 50% chance of angle closure
- Chronic angle closure
- Narrow or occuludable angle

Contraindications

- Significant edema
  - Unable to visualize iris
- Thick iris
  - Dilated pupil. bunched up iris
- High risk of complications
  - Significant inflammation

Pre-operative considerations

- Avoid prostaglandins – can stimulate inflammation
- Immediately prior to procedure
  - 1% pilocarpine three times spaced over 10 minutes
  - Anesthetic gel before procedure
    - Prevents discomfort
  - One drop alpha 2 agonist 30 minutes prior and immediately after procedure
    - Decrease pressure spikes

Procedure of peripheral iridotomy

- Choose 11 or 1 o'clock position
- Start with iris crypt or other thin region
- Target size 500 micro meter in diameter (minimum 200 micrometer)

Post-operative management

- Drop of apraclonidine 1% immediately after
  - Prevents spike
  - Oral CAI if IOP higher than before
- Topical steroid 4 times a day/ 4 days
- Measure pressure 1-2 hours later
- If IOP same or lower- discharge
- See next day
- Perform gonioscopy to asses angle changes
- Life long follow-up as some may become chronic angle closure

Complications

- Elevation of IOP – spike of IOP after procedure
- Accelerated cataract formation
- Some reports of delayed corneal decompensation
  - Angle closure related or may be laser related ?
    - Likely angle closure related
- Monocular blur, ghost images, shadows, glare

laser iridotomy video

Laser iridoplasty

- Procedure to open an appositionally closed angle
- Series of laser burns
  - Low power
  - Large spot
  - Longer duration
  - Extreme peripheral iris
- This causes tightening of peripheral iris creates a space between anterior iris surface and trabecularmeshwork

Laser iridoplasty

Trabeculectomy

Pre-operative preprations

- Medications to stop (1-2 weeks) prior to surgery
  - Eg. Anticoagulants and nonsteriodal anti-inflammatory agents
- Evaluation of conjunctival health
  - Avoid area of previous surgery
  - History of topical medications

Normal conjunctival response to wound healing

- Classic features of acute inflammation
- Hemorrhage on site
  - Releases plasma proteins and blood cells
- Increase in local blood flow and vascular permeability
  - Additionally activation of migration of leukocytes
- Activated inflammatory cells
  - Secrete several cytokines and growth factors are secreted
    - Growth factors in turn recruit fibroblasts
    - This in turn leads to healing and scarring
    - In absence of further injury- apoptosis of t-lymphocytes and fibroblasts

Trabeculectomy

- Creates a fistula that allows aqueous from anterior chamber to subtenons space
- Fistula guarded by scleral flap
- The belb should not be fully vascularized neither completely avascular
- Mytomycin C (alkylating agent) or other antimetabolites (example 5-flurouracil) prevents scarring and failure

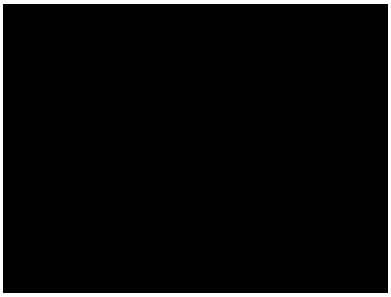
Trabeculectomy Video

- Professor Peng Khaw (recently was knighted by the queen)

Glaucoma implants

- Indications
  - Uncontrolled glaucoma
  - Poor candidates for tabeculectomy
    - Neovascular glaucoma,
    - penetrating keratoplasty or retinal detachments with glaucoma
    - ICE syndromes traumatic glaucoma, previously failed trabeculectomy

Ahmed valve video



Ex-Press device

- Initially at limbus sub-conjunctivally
- Now implantation is under scleral flap

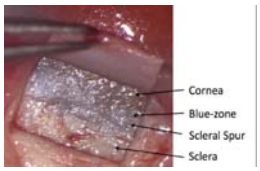
FIGURE 1 The Alcon EX-PRESS™ Glaucoma Filtration Device.

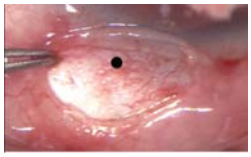
Basic design

- 27 gauge 0.4mm external diameter
- Tube length 2.4 to 3.0mm
- Internal diameter 50 to 200 microns
- The disc or flange prevents intraocular penetration
- Spur like projection lower external surface prevents extrusion

Main concepts Ex-Press

- Controlled aqueous humor flow -50-200 micron internal diameter provides some degree of control
- Trabeculectomy variations occur if sclerotomy performed manually or by a punch





Indications

- Open angle glaucoma
- Pigmentary and pseudoexfoliation syndrome
- Aphakic glaucoma
- Sturge-Weber syndrome
- Secondary uveitis
- Post trauma

Contraindications

- Relative
  - Congenital and juvenile
  - Anterior segment dysgenesis
  - Aniridia
  - Narrow angle
  - AC/IOL and glaucoma
  - Neovascular glaucoma
- Absolute
  - Narrow angle in young patient

Ex-Press implant

Canaloplasty Video

Case 1 SLT in a non compliant patient

Case 2 End stage glaucoma surgical choices

Case 3 Surgical options when subject on maximal medical therapy

Case 4 SLT choice in a pigment dispersion syndrome