Cataract Surgery in Eyes with Glaucoma

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Financial Disclosure

I have the following financial interests or relationships to disclose:

- J&J Vision: P
- Alcon Laboratories, Inc.: P
- Allergan, Inc.: C
- New World Medical: C,P
- Equinox: C,O
- IanTech Medical: P
- FDA C
Patient Case:

- 62 year old male with 12 year history of POAG treated bilaterally with latanoprost and dorzolamide
- IOP is 18/16 & Goal IOP is 16/16.
- Visual field deficit stable over last 3-4 years
- Visually significant cataract bilaterally with angles now open to pTM
- He admits that he forgets to use dorzolamide a few times per week despite repeated educational sessions
- What is your next step?
“MIGS” is getting all the buzz

- any surgical manipulation or device implantation, typically combined with cataract extraction, through a self-sealing incision with minimal trauma to surrounding tissues and results in a measurable, sustained decrease in IOP.
MIGS Wish List

- As effective as trabeculectomy with better safety
- Reproducible/Predictable
- Avoid a bleb
- Easy to perform
- Less post-operative effort
- Cost effective
Cataract Extraction is the best MIGS

- Small cornea based incision
- Excellent safety profile
- Proven sustained IOP lowering
- All options remain for future interventions
Paradigm Shift

- We typically swing for the fences when we do glaucoma surgery.
- Sometimes low risk with less IOP lowering is the correct choice.
Paradigm Shift

AVOID

TRAB/GDD

CE

MIGS

GOAL

RISK

IOP LOWERING
The Science of IOP Lowering After CE

Open Angles:

- The level of IOP lowering after cataract surgery is likely due in some part to “TM ECM remodeling” (see IL-1/e-selectin)
- Similar to laser trabeculoplasty?
- We routinely see significant and persistent IOP lowering even when preoperative angles are wide open

Ultrasound Activates the TM ELAM-1/IL-1/NF-κB Response: A Potential Mechanism for Intraocular Pressure Reduction after Phacoemulsification

Nan Wang,1 Shravan K. Chintala,1,2 M. Elizabeth Fini,1,3 and Joel S. Schuman1


**Figure 1.** IL-1α accumulation in cell culture medium conditioned by normal TM cells after treatment with phacoemulsification ultrasound energy. Culture medium was collected at the indicated time points after phacoemulsification ultrasound energy (phaco) or sham treatment, and IL-1α content was quantified by ELISA. The error bars indicate SD from the mean. n = 8; P = 0.0006 at 4 hours, 0.0005 at 24 hours, and 0.0029 at 40 hours.

**Figure 2.** IL-1α accumulation in cell culture medium conditioned by glaucomatous TM cells after treatment with phacoemulsification ultrasound energy. Medium was examined as in Figure 1. The error bars indicate SD from the mean. n = 7; P = 0.11 at 4 hours, 0.29 at 24 hours, and 0.68 at 40 hours.
The Science of IOP Lowering After CE

Narrow Angles:

▪ The level of IOP lowering after cataract surgery is proportional to the resultant widening of the angle.

▪ Lens vault may be predictive of IOP lowering.

▪ Gonioscopy and AS-OCT: Angle morphology, characteristics of the iris, and the lens vault.

▪ Not very effective in chronic angle closure (AS).

▪ **Pearl:** Place LPI temporally so that it will fall under an incision at time of CE.
The Science of IOP Lowering After CE

- ECM remodeling and change in angle configuration are both relevant to the mechanism of IOP lowering.

- Studies are underway with advanced imaging as well as protein sampling to better understand the processes involved.
Acute Angle Closure

- **Phaco is a great option**
- Lam et al: 31 eyes with AAC + Cataract
  - Phaco had lower IOP, less meds, better VA

### Table 4. Reported Prevalence of Intraocular Pressure (IOP) Rise after Acute Primary-Angle Closure (APAC) in the Literature

<table>
<thead>
<tr>
<th>Study</th>
<th>Treatment</th>
<th>Prevalence of IOP Rise at Different Follow-up Time Points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>≤6 mos</td>
</tr>
<tr>
<td>Aung et al (2001)</td>
<td>Medications + LPI</td>
<td>44.5% (6 mos)</td>
</tr>
<tr>
<td>Lai et al (2002)</td>
<td>ALPI + LPI</td>
<td>20.0% (6 mos)</td>
</tr>
<tr>
<td>Lim et al (2004)</td>
<td>Medications + LPI</td>
<td>34.1% (4 mos)</td>
</tr>
<tr>
<td>Lai et al (2006)</td>
<td>ALPI + LPI</td>
<td>NA</td>
</tr>
<tr>
<td>Present study (2007)</td>
<td>Medications + LPI</td>
<td>32.3% (6 mos)</td>
</tr>
<tr>
<td>Present study (2007)</td>
<td>Medications + early phacoemulsification</td>
<td>3.2% (6 mos)</td>
</tr>
</tbody>
</table>

ALPI = argon laser peripheral iridoplasty; LPI = laser peripheral iridotomy; NA = not available.

Role of Early Lens Extraction (EAGLE) being investigated
Effectiveness of early lens extraction for the treatment of primary angle closure glaucoma (EAGLE): A randomized Controlled Trial


• Best approach to treating PAC or PACG → SOC vs CLE
• Age 50 or over and IOP 30mmHg or higher or PACG
• 419 patients (155 PAC and 263 PACG)
• 208 assigned to CLE and 211 to SOC
• IOP was 1.18mmHg lower in CLE vs SOC
• **Conclusion**: CLE showed greater efficacy and was more cost effective than SOC/LPI and should be considered as first line therapy
Chronic angle closure

Tham et al.

- RCT of phaco vs phaco-trabeculectomy
- 2008 - Medically *controlled* CACG
  - No difference in IOP after 3 months
  - Phaco-trab on less meds but more complications
- 2009 - Medically *uncontrolled* CACG
  - Phaco alone lowered IOP by 8 mmHg
  - Phaco-trab
    - Lower mean IOP at 18 mo: 13.6 vs 15.9 mmHg
    - Mean of 1.25 less postop meds
    - More complications AND progression of optic neuropathy
Purpose—To determine the change in intraocular pressure (IOP) after cataract extraction in the Observation Group of the Ocular Hypertension Treatment Study (OHTS).

Participants—Forty-two participants (63 eyes) who underwent cataract surgery in at least one eye during the study and a control group of 743 participants (743 eyes) who did not undergo cataract surgery.

Methods—Defined the “split date” as the study visit date that cataract surgery was reported in the cataract surgery group, and a corresponding date in the control group. Preoperative IOP was defined as the mean IOP of up to 3 visits prior to split date.
The estimated mean decrease in IOP postoperatively in the cataract surgery group was 4.0 mm Hg.

The control group had a slight mean decrease in IOP of 0.3 mm Hg.
Reduction in Intraocular Pressure After Cataract Extraction: the Ocular Hypertension Treatment Study

<table>
<thead>
<tr>
<th>Percent Change in Mean Postoperative IOP from Mean Preoperative IOP*</th>
<th>Number of eyes</th>
<th>Percent of Eyes</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 30% Decrease</td>
<td>10</td>
<td>15.9%</td>
</tr>
<tr>
<td>20% to 29% Decrease</td>
<td>15</td>
<td>23.8%</td>
</tr>
<tr>
<td>10% to 19% Decrease</td>
<td>20</td>
<td>31.7%</td>
</tr>
<tr>
<td>0% to 9% Decrease</td>
<td>11</td>
<td>17.5%</td>
</tr>
<tr>
<td>Increase from preoperative IOP**</td>
<td>7</td>
<td>11.1%</td>
</tr>
</tbody>
</table>
Long-term effects of phacoemulsification with intraocular lens implantation in normotensive and ocular hypertensive eyes

Brooks J. Poley, MD, Richard L. Lindstrom, MD, Thomas W. Samuelson, MD

Table 2. Characteristics and IOP results by presurgical IOP group.

<table>
<thead>
<tr>
<th>IOP (mm Hg) Group</th>
<th>Eyes (n)</th>
<th>Age (Y)</th>
<th>Postop FU (Y)</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>At Surgery</td>
</tr>
<tr>
<td>31-23</td>
<td>19</td>
<td>69.3 ± 7.4</td>
<td>2.4 ± 2.4</td>
<td>24.5 ± 2.1</td>
</tr>
<tr>
<td>22-20</td>
<td>62</td>
<td>70.9 ± 10.3</td>
<td>4.6 ± 2.2</td>
<td>20.9 ± 0.8</td>
</tr>
<tr>
<td>19-18</td>
<td>86</td>
<td>67.4 ± 11.6</td>
<td>4.9 ± 2.9</td>
<td>18.3 ± 0.4</td>
</tr>
<tr>
<td>17-15</td>
<td>223</td>
<td>71.2 ± 9.9</td>
<td>4.7 ± 2.6</td>
<td>15.9 ± 0.7</td>
</tr>
<tr>
<td>14-9</td>
<td>198</td>
<td>70.5 ± 10.5</td>
<td>4.2 ± 2.6</td>
<td>12.7 ± 1.4</td>
</tr>
<tr>
<td>P value</td>
<td>—</td>
<td>.57</td>
<td>.002</td>
<td></td>
</tr>
<tr>
<td>All eyes</td>
<td>588</td>
<td>70.3 ± 10.4</td>
<td>4.5 ± 2.6</td>
<td>16.0 ± 3.1</td>
</tr>
</tbody>
</table>

FU = follow-up; IOP = intraocular pressure

J Cataract Refract Surg 2008; 34:735–742
Mean number of glaucoma drops was 1.3 before surgery and 1.0 at the final measurement.
Question:

Which mechanism has been linked with IOP lowering in glaucoma eyes post cataract extraction

A. TM ECM changes related to ultrasound
B. Degree of lens vault preoperatively
C. Both A&B
D. None of the above
Question:

Which mechanism has been linked with IOP lowering in glaucoma eyes post cataract extraction

A. TM ECM changes related to ultrasound
B. Degree of lens vault preoperatively
C. Both A&B
D. None of the above
It seems that CE would be an awful control group when studying the efficacy of glaucoma procedures!
Learning from MIGS Trials
Glaukos iStent: US IDE Trial

- **Primary outcome:** IOP \(< 21\) mm Hg without meds

<table>
<thead>
<tr>
<th>Follow-Up</th>
<th>Phaco+iStent</th>
<th>Phaco</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 year(^1)</td>
<td>72%</td>
<td>50%</td>
<td>(&lt;0.001)</td>
</tr>
<tr>
<td>2 years(^2)</td>
<td>71%</td>
<td>61%</td>
<td>0.036</td>
</tr>
</tbody>
</table>

IDE included 240 eyes

- **Secondary outcome:** IOP reduction \(\geq 20\%\) without meds

<table>
<thead>
<tr>
<th>Follow-Up</th>
<th>Phaco+iStent</th>
<th>Phaco</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 year(^1)</td>
<td>66%</td>
<td>48%</td>
<td>0.003</td>
</tr>
<tr>
<td>2 years(^2)</td>
<td>61%</td>
<td>54%</td>
<td>0.09</td>
</tr>
</tbody>
</table>


CyPASS COMPASS TRIAL

- **Inclusion criteria**
  - Primary open-angle glaucoma
  - Schaffer grade 3–4 angle (gonioscopy)
  - Unmedicated diurnal IOP 21–33 mmHg

- **Randomized intervention**
  - Control (Phaco-only; n=131)
  - Stent (CyPass® Micro-Stent + Phaco; n=374)

- **Endpoints (24-month time point)**
  - Proportion of patients with a ≥20% reduction in unmedicated, diurnal IOP
  - Mean change in unmedicated, diurnal IOP
  - Proportion of eyes with unmedicated, diurnal IOP ≥6 mmHg and ≤18 mmHg

Hydrus from Ivantis

- **Design:** Prospective, controlled, randomized, multi-center trial. (n=100)

- **Primary Endpoint:** washed-out diurnal IOP at 24 months.

- **Outcome:** Significant IOP lowering that is sustained for two years.

Note of Caution

- Patients with low preoperative IOP may have higher IOPs after uncomplicated surgery.

- Poley et al data on patients with Pre-op IOP of 15-17:
  - 55% had lower IOP
  - 30% had higher IOP
  - 15% no change
  - If IOP <15mmHg 55% of patients had a higher IOP

- Post-Trab patients: IOP may increase by ~2 mmHg on average. 30% to 50% of patients may require additional medication.

Patient Case:

- 62 year old male with 12 year history of POAG treated bilaterally with latanoprost and dorzolamide
- IOP is 18/16 & Goal IOP is 16/16.
- Visual field deficit stable over last 3-4 years
- Visually significant cataract bilaterally with angles now open to pTM
- He admits that he forgets to use dorzolamide a few times per week despite repeated educational sessions
- What is your next step?
  - CE alone decrease IOP to 14mmHg in both eyes off all meds
What is my Practice Pattern?

- G/S and OHT → Phaco only
- Glaucoma with controlled IOP on 1-3 meds → Phaco+
- Glaucoma with uncontrolled IOP on 1-3 meds → Phaco+
- In most cases, trabs and tubes are reserved for pseudophakes who failed above
What does EBM Teach Us?

- Phaco alone as an IOP lowering procedure should be considered in all patients with glaucoma and visually significant cataracts

  - Phaco alone is a viable first line surgical option for narrow angle glaucoma
  
  - Phaco alone is also a viable option for controlled glaucoma on 1-2 medications (Improve vision and good chance of getting off one drop)

  - In setting of uncontrolled glaucoma with open angles, CE alone EBM is evolving. Patient + Surgeon decision when possible (consider phaco+ or sequential surgery)

In many cases, the art of medicine matters just as much as the science.
Special Circumstances:

- Goniosynechialysis (GSL)
- Micro-invasive Glaucoma Surgery (MIGS)
Who is a candidate for GSL?

- Phakic patient with primary angle closure glaucoma (PACG): Combine CE + GSL
- CACG with elevated IOP and at least 50% of the angle sealed with PAS is a good candidate for CE + GSL
- Many have advocated for “fresh” (6-12 months) PAS as being ideal***
- Standalone GSL may have IOP benefits in CACG but this is controversial and likely dependent on timing***
Who is not a candidate for GSL?

- Eyes with very advanced cupping and central visual field defects where IOP spikes are more worrisome post-operatively

- Caution in patients on anti-coagulant and anti-platelet therapy

- Active uveitis or chronic recurrent uveitis (GSL is effective after a long period with no recurrence)
Potential Complications from GSL:

- **Hyphema**: Bleeding usually seen during IA and inflating AC with meticulous hydration or suturing of wounds is key.

- **Chronic inflammation**: Minimize tugging on iris and increase use of steroids post-operatively.

- **Iridodialysis or cyclodialysis +/- Hypotony**: Rare complication usually resulting from central pull rather than downward push.
Question

Who is a candidate for goniosynechialysis (GSL):

A. Only pseudophakic patients
B. Only phakic patients
C. CACG with over 50% PAS
D. None of the Above
Question

Who is a candidate for goniosynechialysis (GSL):

A. Only pseudophakic patients
B. Only phakic patients
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D. None of the Above
Evolution of Surgical Glaucoma

What is MIGS*:

• Ab-interno approach that is minimally traumatic
• At least modest efficacy that is sustained
• Extremely high safety profile
• Rapid recovery with minimal impact on quality of life

*Defined by Dr. Ike Ahmed
Pre-operative

- When combined with CE
  - Consent should always include “+/-” statement
  - Discuss recovery may be a bit different compared to CE
  - Dilation and preoperative drops as usual
  - Discuss positioning prior to the case (turning head)

- Standalone
  - Antibiotic + Pilocarpine 1% q5m x 3
  - As above
Intra-operative

- Use miotic in first few cases to enhance view
- Routine cases and cooperative patients
- Consider peribulbar anesthetic
- Hydrate the wounds well
- Leave IOP at ~25mmHg at the end of the case
Post-operative

- Treat similar to cataract patients

- Antibiotic/Steroid/NSAID +/- Pilocarpine 1% when combined with CE

- Antibiotic/Steroid +/- Pilocarpine 1% with standalone

- See back post op day one
Follow Up Pearls

▪ Steroid response is not uncommon after ab interno procedures

▪ Stop all meds when IOP < 15mmHg

▪ Keep 1-2 meds as needed depending on nerve status and IOP

▪ Restart meds one by one as needed
Which statement is true

A. Glaucomatous eyes can still experience steroid response and IOP elevation
B. MIGS approaches lead to more rigorous post-operative follow-up compared to CE alone
C. MIGS approaches rarely lead to a decrease in IOP lowering medications
D. All the above are true
Question

Which statement is true

A. Glaucomatous eyes can still experience steroid response IOP elevation
B. MIGS approaches lead to more rigorous post-operative follow-up compared to CE alone
C. MIGS approaches rarely lead to a decrease in IOP lowering medications
D. All the above are true
Summary

- Standalone cataract surgery is an excellent IOP lowering procedure
- Narrow angles, in some but not all circumstances, benefit from early CE
- GSL is an important skill to master when caring for glaucoma patients in the OR
- MIGS procedures require diligent practice
- Learning specific angle based surgery pearls can enhance patient satisfaction and IOP lowering outcomes
We continue to learn from each other and have many options compared to the not too distant past.
Thank You