Intracameral Dilation
(Still A Work in Progress)

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Intracameral Dilation Regimen

• Innovators in intracameral injections for dilation
  - Cionni, et al—IC lidocaine (supplemented with epinephrine)
  - Lundberg and Behndig—IC lidocaine, phenylephrine, and cyclopentolate, then IC lidocaine and phenylephrine without cyclo
  - Myers & Shugar—IC "Epi-Shugarcaine” with preoperative tropicamide

• Trends for intracameral injection:
  - Faster acting agents (shorter half-life)
  - Lidocaine is a common thread
    • Relaxes iris sphincter
  - Parasympathetic antagonists
    • Tropicamide preoperatively
    • Cyclopentolate intraoperatively
  - Sympathetic agonists
    • Epinephrine
    • Phenylephrine (Europe and Canada)

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The Weak Link in Dilation

- Topical phenylephrine (PE) compared to intracameral epinephrine
  - Is less potent at alpha receptors for dilation
  - Has far weaker beta-adrenergic effect to relax iris sphincter
  - Longer half-life means slower onset of effect
  - Impedes the effectiveness of intracameral epinephrine by blocking iris receptors

- In patients on beta-blockers:
  - Systemic absorption can cause significant hypertension due to vasoconstriction from the unopposed alpha-adrenergic effect (can be seen with calcium channel blockers as well)
  - Beta-blockade extends to iris sphincter making the less-active PE a poorer choice for dilation

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4. Katzung Bertram G Basic & Clinical Pharmacology Chapter 9, Pg 133
Intracameral Dilation

(2009) A non-matched study found the following:
- We can eliminate phenylephrine from the preoperative topical regimen
- We can’t use intracameral tropicamide to replace topical tropicamide.
- But, intracameral tropicamide may supplement topical tropicamide.

(2010) Based on these findings, consideration was given to the following subjective/objective observations
- Diluted lidocaine did not provide as effective anesthesia 1% lidocaine
- Diluted epinephrine did not stabilize the stroma as effectively

The following regimen was created:
- IC Tropicamide .1% with 1% Lidocaine and half-strength Epinephrine
  - Supplemented by pre-operative topical 1% tropicamide (“IC Tropicamide Mix”)
    (compounded 2% tropicamide and 2% lidocaine mixed 50:50 with non-preserved epinephrine)
- Compared in a fellow eye study to preoperative topical 1% Cyclopentolate and 10% Phenylephrine (with 1% IC Lidocaine) (“Topical Drops”)
- 24 patients (11F, 13M), ave age 73.8 (+/- 7.3 yrs)
- All surgeries carried out between October, 2009 and March, 2010 and spaced no more than one month apart.
- Although tamsulosin was not specifically evaluated in the study, two patients were dropped from the evaluation for starting tamsulosin between the performance of the two surgeries. (Neither informed our office specifically, but one notified the surgery center upon arrival)
- The assumption is that all other medications were the same between the two surgeries (and gender as well . . .)
Tested Regimens (so far)

(2009) Intracameral Regimen Study
• IC Lidocaine
  - With cyclopentolate .1% and phenylephrine 1% (13m, 8f, ave 72.4 yo) (Note: Lundberg/Behndig solution contained 1.5% PE)
• IC Lidocaine & Epinephrine (Epi-Shugarcaine)
  - Alone (9m, 15f, ave 74.5 yo)
  - With topical tropicamide (5m, 9f, ave 72.1 yo)
• IC Tropicamide with Epi-Shugarcaine
  - With .1% intracameral tropicamide (8m, 23f, 71.6 yo)
  - With topical and .05% intracameral tropicamide (10m, 8f, ave 74.8 yo)
  - With topical and .1% intracameral tropicamide (3m, 4f, ave 71.6 yo)
• Each regimen was tested on a per day basis
  - Fellow eye studies impractical when trying to evaluate a number of different combinations rather than a head-to-head comparison of two different agents or combinations of agents

(2010) Fellow Eye Study (11f, 13m, ave 73.8 yo)
• Compounded Topical Drops
  - 1% Cyclopentolate & 10% Phenylephrine
  - Supplemented with 1% IC Lidocaine
• IC Tropicamide .1% with 1% Lidocaine and half-strength Epinephrine
  - Supplemented by pre-operative topical 1% tropicamide
Measuring Pupil Dilation

- Using the “software ruler” of the Surgical Media Center (SMC) from Abbot Medical Optics, each of the following stages in cataract surgery was measured for each of the tested regimens. (seconds gives a rough interval after the start of the case)
  - At start of procedure (15 sec)
  - After first agent instillation (60 sec)
  - After second agent instillation (90 sec) (2009 testing only)
  - Viscomydriasis/Capsulorhexis (2 min)
  - Mid-Phacoemulsification (3 min)
  - Mid-IOL insertion (5 min)
  - End of Case (6 to 7 min)
- Length of procedure also compared between regimens
  - Speed of dilation will improve the efficiency of the surgery
  - Effective pupil size and tone will speed the surgery as well
- Cases were eliminated in 2009 and 2010 if the pupil size was not captured for accurate measurement
  - Surgical case too far off-screen
  - Video did not get started, or did not get started on time
The SMC Software Ruler

Pre-dilation          IC Epidilation          IC Epi-Shugarcaine      IC Tropicamide .1%

Capsulorhexis      Phacoemulsification     IOL Implantation          End of Case
Relative Dilation Failures

Defined a failure to dilate at 6 mm (an arbitrary measurement based on optic diameter)
- Pupil did not achieve a 6 mm dilation
- Pupil did not maintain a 6 mm dilation from phacoemulsification to the end of the case

2009 Intracameral Dilation Study
- IC cyclopentolate/PE failed in 6 of 21 (3m, 3f) cases
  - Most billowing of the iris stroma of any regimen
- Epi-Shugarcaine dilated quickest, but failed in 8 of 24 cases (3m, 5f)
  - Although the pupil was a bit smaller, the iris tone was good
- IC tropicamide .1% dilated slower, but was slightly more effective at retaining dilation combined with Epi-Shugarcaine (8 of 31, 3m, 5f)
  - Slightly better dilation, iris tone equal to Epi-Shugarcaine group

2010 Fellow-Eye Study
- Topical drops alone failed in 1 of 24 (1m) with 5 (4m, 1f) at less than 6 mm by the end of the case
- IC Tropicamid mix failed in 2 of 24 (3m, 2f) with 6 (5m, 1f) at less than 6 mm by the end of the case
- The single failure in each series to reach 6 mm at any point were fellow eyes of the same patient (male), however, only three below 6 mm at the end of the case were fellow eyes (3m)

No surgical case in either 2009 or 2010 required a pupil-expanding device or pupil stretching, nor were any eliminated from the study for that reason.
Benefits of Topical Tropicamide

- Topical tropicamide 1% improved all measured dilation parameters (38 of 39 successful) compared to intracameral agents alone (p < .00005)
- Viscomydriasis was effective with either dispersive viscoelastic used (Viscoat or Healon-D)
  - Pre-op Tropicamide: 0.7 mm
  - No Pre Tropicamide: 1.1 mm
- Regardless of dilation regimen, average pupil size decreased from phacoemulsification to the end of the case
  - Average: .75 mm
Topical and IC Tropicamide

- (2009) Topical tropicamide 1% improved all measured dilation parameters for Epi-Shugarcaine.
  - $p < .0001$ for phaco, IOL and end-case measurements
- (2009) Intracameral tropicamide improved dilation parameters for Epi-Shugarcaine
  - $p < .06$ for phaco
  - $p < .05$ for end-case
- (2009) Intracameral tropicamide did not appear to supplement topical tropicamide in a statistically-significant fashion, although surgical case times were faster than without it.
  - Hence, the 2010 study
- (2010) The IC Tropicamide Mix resulted in dilation close to that of Topical Drops.
  - Starting dilation was obviously different ($p = .00029$), as was pupil size just prior to viscoelastic inflation of the anterior chamber ($p = .08$)
  - For capsulorhexis, phacoemulsification, IOL implantation and end of case, the dilation was virtually the same ($p = .11$ to .27)
- (2010) No significant differences in iris tone were recorded between the two groups.
Surgical Procedure Times

Procedure times were measured from first incision to completion of the surgery.

(2009) Procedure times were inversely related to effectiveness of dilation.

- IC Lidocaine & Epinephrine (Epi-Shugarcaine)
  - With topical and .1% IC tropicamide: 6:18
  - With topical and .05% IC tropicamide: 6:38
  - With topical tropicamide: 6:42
  - With .1% IC tropicamide: 6:49
  - Alone: 7:04

- IC Lidocaine
  - With cyclopentolate .1% and phenylephrine 1%: 7:26

(2010) The current study compared standard topical drops to the specified intracameral mixture (one step eliminated from 2009 study, probably 20 to 30 seconds):

- IC Lidocaine 1%, Tropicamide .1% & half-strength Epinephrine
  - With pre-operative tropicamide: 5:24 (std dev 49s)

- Topical 1% Cyclopentolate/10% Phenylephrine
  - With IC Lidocaine: 5:17 (std dev 61s)

- The two tested regimens had no difference in surgical case time, p = .33, suggesting no delay in allowing IC agents to work, nor a significant difference in iris characteristics to influence surgical time.
Conclusions (So Far)

- Intracameral dilation is effective for cataract surgery
  - No significant differences in dilation compared to topical drops
  - No differences in surgical case times
    - IC agents work quickly (no delay)
    - Iris behavior similar to topical agents
  - Subjective absence of stinging from topical drops is a benefit
  - Topical phenylephrine is not necessary on a routine basis
- Higher concentration of epinephrine has an improved effect
- Pre-operative topical tropicamide 1% enhances the effects of all tested intracameral agents
  - IC Tropicamide appears to enhance this effect
- But, physiology will remain variable between individuals despite our efforts at standardization
  - Very difficult to standardize exposure time of pre-operative topical agents
  - Standard topical drops do sting and the resulting epiphora may dilute the effect of these drops