Glaucoma -
Ocular hypertension
Primary angle closure
Natural therapies for glaucoma

Dr. Justin Mora

What is Ocular Hypertension?
Intraocular pressure above the upper limit of normal but with no glaucomatous optic neuropathy or glaucomatous visual field changes

...but what is normal IOP?
≤ 21 mmHg
≤ 22 mmHg?
Ocular Hypertension

• What is a normal IOP?
  - M = Median IOP
  - A = Population IOP distribution
  - B = Bell curve
  - C = Glaucoma

'Strange' may be different at different times of the day

- PACG and normals - late afternoon peak
- POAG early morning peak

Circadian Variation in IOP

And... Diurnal changes are not consistent

Review of Ophthalmology 2011
Should we consider these issues?

- Each decade after 40 is associated with a 1 mmHg increase of IOP
  - Should we make an allowance for that?
- Factors which can decrease IOP
  - Dehydration, metabolic acidosis
- Factors which may increase IOP
  - Raised venous pressure – valsalva, head down (yoga, lying down), tight necktie, rapid fluid intake, exercise

Measured IOP may vary with different assessment tools

- Goldman versus non-contact tonometry and tonopen
  - NCT and tonopen consistently higher
  - More so with increasing IOP and CCT
    (Kim et al. Curr Eye Res Apr 2011)

Goldman readings may be flawed

- IOP reading artificially low
  - Insufficient fluorescein in tear film, thin cornea
- IOP reading artificially high
  - Excessive fluorescein, eyelid pressure from blepharospasm, digital pressure while holding lids open, thick cornea
- Technical issues
  - Corneal scars, excessive astigmatism, nystagmus, tremour, small palpebral apertures
Corneal thickness

What allowance do we make for CCT?

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Formulae for adjusting IOP for CCT

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Formulae to adjust intraocular pressure measured by tonometry for central corneal thickness.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Formula Name</strong></td>
<td><strong>Formula</strong></td>
</tr>
<tr>
<td>Corssang's (^{1,2})</td>
<td>[ IOP = \frac{5.0 \times (Tg - 0.520)}{0.070} ]</td>
</tr>
<tr>
<td>Wiltse's (^{1,2})</td>
<td>[ IOP = \frac{2.0 \times (Tg - 0.520)}{0.100} ]</td>
</tr>
</tbody>
</table>

\[ IOP = \frac{IOP}{K} \text{ where} \]

*Brandt et Al. Ophthalmology March 2012*
The Ocular Hypertension Treatment Study

- 1636 Participants aged 40-80 with no glaucoma damage
- IOP 24-32 mmHg in one eye and 21-32 mmHg in the other
- Randomised to Rx or no Rx over 5 years
- Mean IOP reduction of 22.5% ± 9.9%
- Cumulative probability of developing POAG:
  - Rx group: 4.4%
  - No Rx group: 9.5%

OHTS risk factors

- Based on the data from the OHTS we have a series of factors we can use to assess the risk of progression to glaucoma for an individual patient over 5 years
  - Patient age
  - Intraocular pressure
  - Corneal thickness
  - C:D ratio
  - VF mean pattern standard deviation (by definition minimal)

- [http://ohts.wustl.edu/risk/continuous%20method.pdf](http://ohts.wustl.edu/risk/continuous%20method.pdf)
- For i-Phones - OHT Calc: $1.29
- For Androids - Glaucoma Calculator: $1.30
<table>
<thead>
<tr>
<th>FACTORS</th>
<th>RIGHT EYE MEASUREMENTS</th>
<th>LEFT EYE MEASUREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>g0</td>
<td>g1</td>
</tr>
<tr>
<td>Unilateral Intercorneal Pressure</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Central Corneal Thickness</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Vertical Cup to Disc Ratio by Central Corneal</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Intraocular Pressure</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

3.5%
### CONTINUOUS METHODS FOR ESTIMATING 5-YEAR RISK OF DEVELOPING PAGS

Factors:

<table>
<thead>
<tr>
<th>FACTORS</th>
<th>RIGHT EYE MEASUREMENTS</th>
<th>LEFT EYE MEASUREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Unilateral Intercorneal Pressure</td>
<td>700 450</td>
<td>650 400</td>
</tr>
<tr>
<td>Central Corneal Thickness</td>
<td>0.5 0.5</td>
<td>0.4 0.5</td>
</tr>
</tbody>
</table>

**Risk Calculation:**

28.1%
But for each individual patient there are other factors we need to consider too.

Cup size relative to nerve size

- Assess with a 60D or 78D lens using the S/L graticule

<table>
<thead>
<tr>
<th>Disc Diameter</th>
<th>Mean Vertical C:D ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1.0 mm</td>
<td>0.26</td>
</tr>
<tr>
<td>1.2 mm</td>
<td>0.33</td>
</tr>
<tr>
<td>1.4 mm</td>
<td>0.39</td>
</tr>
<tr>
<td>1.6 mm</td>
<td>0.45</td>
</tr>
<tr>
<td>1.8 mm</td>
<td>0.50</td>
</tr>
<tr>
<td>≥ 2.0 mm</td>
<td>0.55</td>
</tr>
</tbody>
</table>
But we know how to assess optic nerves for glaucoma don’t we?

- C.D ratio, ISNT rule, shelving, notching, Drance haems, baring of vessels, PPA, laminar exposure
  - 2 glaucoma experts diagnosed NTG on the basis of ONs
  - Watched for 8 yrs to see if OCT changes pre-dated VF changes
  - How many of these definite NTG cases progressed over 8 yrs?
  - 21%

Other issues to consider:

- Family history
- Medications – any plan to stop an oral beta-blocker?
- PXF
- PDS
- Large IOP fluctuations more likely to progress
- Years to see
  - patient age, family longevity, co-morbidities
What to do with an ocular hypertensive?

• Back yourself to assess and judge the risk
  – Don't take the IOP reading in isolation
  – Don't take the OHTS risk calculator in isolation

• Get as much baseline information as you can:
  – CCT
  – VF - Matrix or Humphrey threshold
  – Nerve fibre layer assessment – OCT or GDx
  – Optic Nerve Photos

Cases: In otherwise healthy eyes...

• Borderline elevation
  – IOP 22 RE, 23 LE
  – Does not warrant referral

• Difference in IOP between eyes
  – IOP 16 RE, 22 LE
  – Does not warrant referral

• Labile IOP
  – IOP usually 16 but this visit 21
  – Does not warrant referral

Management

• Talk to the patient and try to give him/her a realistic assessment of the risk

• Be guided by the patient and what he/she wants

• Either watch for change over time
  – Annual or two-yearly review depending on risk profile

• Or refer for baseline work-up and risk analysis
  – If judged low risk then expect to do the ongoing monitoring
Assessing angle closure

Definitions

- **Primary Angle Closure Suspect**
  - Appositional contact between iris and post TM present or possible. 180-270 degrees of post TM not visible
- **Primary Angle Closure**
  - PACS with raised IOP or anterior synechiae
- **Primary Angle Closure Glaucoma**
  - PAC with glaucomatous optic neuropathy
- **Plateau Iris Configuration**
  - An occludable angle in the absence of pupil block
- **Plateau Iris Syndrome**
  - Angle closure in the presence of a patent iridotomy

Angle assessment

Van Herrick

<table>
<thead>
<tr>
<th>Grade</th>
<th>Irideocorneal contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Iridocorneal contact</td>
</tr>
<tr>
<td>1</td>
<td>Peripheral ACD &lt; ½ corneal thickness</td>
</tr>
<tr>
<td>2</td>
<td>Peripheral ACD ½ - ⅔ corneal thickness</td>
</tr>
<tr>
<td>3</td>
<td>Peripheral ACD ≥⅔ corneal thickness</td>
</tr>
</tbody>
</table>

- Sensitivity - 61.8 %
- Specificity - 89.3 % (with raised IOP 99.3 %)
Performing gonioscopy

- Dim room
- Good local anaesthesia
- Gonioscopy lens that will allow for indentation to check for appositional vs synechial closure
- High magnification
- Short (1mm), narrow beam, low illumination, away from the pupil
- Examine all 4 quadrants
- Minimal pressure on lens and indent only if necessary

Grading your findings

Shaffer

<table>
<thead>
<tr>
<th>Grade 0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shaffer</td>
<td>closed</td>
<td>10°</td>
<td>20°</td>
<td>30°</td>
</tr>
<tr>
<td>Modified</td>
<td>Schwalbe’s line not visible</td>
<td>Schwalbe’s line visible</td>
<td>Anterior TM visible</td>
<td>Scleral spur visible</td>
</tr>
</tbody>
</table>

Grading your findings

Spaeth

1. Iris insertion
   - A = anterior to Schwalbe’s line
   - B = Behind Schwalbe’s line
   - C = Centered at scleral spur
   - D = Deep to scleral spur
   - E = Extremely deep / on ciliary band

2. Angular width
   - slit | 10° | 20° | 30° | 40°

3. Peripheral iris configuration
   - Queerly concave | Regular | Steep

4. TM pigment
   - Grade 0 - 4
• Angle assessment as per ANZGIG and Asia Pacific glaucoma guidelines

Further angle assessment

- If the scleral spur is not visible then is the patient a PACS?
- Primary Angle Closure Suspect
  - ≥ 180 degrees of post TM not visible
  - Appositional contact between iris and post TM present or possible

Other considerations:

- Angle closure glaucoma in the other eye
- Family history of angle closure
- Symptoms – haloes, evening blur/ache
- Pigment deposition on TM
- Shallow central AC/high hyperopia
- Need for repeated dilated examinations
- Poor access to emergency care
Examples

- Two patients with posterior TM visible thru 180°
  - No FHx of glaucoma
  - Normal VF, NFL OCT and optic nerve appearance
- Patient 1
  - Pigment deposition on TM
  - No headaches but haloes around lights at night
  - Travels overseas frequently
- Patient 2
  - History of headaches but any time of day and no associated blur or haloes
  - No pigment on TM

What is the role of angle imaging?

- OCT has taken over from ultrasound biomicroscopy (UBM)
- Measures
  - AOD 500 (mm) - angle opening distance - from a point 500 µ anterior to scleral spur to opposing point on iris
  - Angle recess area (mm²) – triangle bounded by AOD 500 and the inner corneoscleral wall
  - Trabecular space area (mm²) – trapezoidal area bounded by AOD 500, inner corneoscleral wall and distance between scleral spur and iris
- Angle may vary thru 360° and OCT takes just a sample in one or a few zones
- Still an adjunct and a research tool rather than an alternative to gonioscopy

Treatment of primary angle closure

- Medical treatment of narrow angles
  - Long term Pilopt not appropriate
  - After PAC crisis 50 % of fellow eyes affected in 5 years
  - 40% of those treated with Pilopt affected
Laser Peripheral Iridotomies

- Pre-Rx with Pilocarpine
- Paracetamol for brow ache
- Fewer dysphotopsias with LPIs temporally vs superiorly (2.4% vs 6.5% of 338 eyes at 1/12, even with complete lid coverage) - AJO May 2014
- Target thin area/iris crypt
- Pigment rush once patent
- Blues irides easier. Very dark eyes may warrant argon laser pre-Rx to thin
- Topical steroids for one week
- Review and reassess angle

Primum non nocere

- Laser iridotomy risks
  - Bleeding and inflammation
  - Dysphotopsias
  - Lens opacities
  - Corneal injury

If the angle remains occludable?

- Iridoplasty
  - If LPI is poorly effective
  - Iridoplasty can thin and contract iris
  - Use gonio lens to apply
  - Avoid corneal arcus
  - Long low dose 30-50 applications over
- Risks
  - Corneal endothelial injury
  - Pigmentary change
Lens Extraction

- A definitive procedure
- Without cataract, difficult to justify as a preventative in the absence of one or more of:
  - PAS
  - Elevated IOP
  - PACG symptoms

If the angle opens well?

- Prognosis post LPIs
  - The angle may narrow again over time
  - Annual or 2 yearly review warranted long term

Natural Therapies for Glaucoma
Marijuana

- Legal use advocated for
  - Chemotherapy-related nausea
  - Appetite stimulation for HIV wasting
  - Movement disorders
  - Analgesia
  - Glaucoma

Marijuana and Glaucoma

- Advocated initially in the 70's
- Limited options for glaucoma treatment:
  - miotics, epinephrine, acetazolamide
- Various studies have produced data from a total of 300 volunteer subjects
- Largest single study group was 40 people

Marijuana and Glaucoma

- Inhaled marijuana lowers IOP in 60-65%
- Smoking 1 joint reduces IOP by 25%
- Impressive results but......

Marijuana and Glaucoma

- Duration of effect only 3-4 hrs
- For a consistent response one would have to smoke:
  - 8-9 / day
  - 3000 / year

JAMA 1980; 244(22): 2498

No green light for grass in glaucoma!

Ginkgo Biloba

- Used in Chinese medicine for 5000 yrs
- Leaf extract of Maidenhair tree
- "Fossil" tree, only survivor of earliest family of trees, from Permian period 250m yrs ago
- Most commonly prescribed drug in Germany
Ginkgo Biloba

- Peripheral vascular disease
- Cognitive disorders / improving cognitive function
  - In Alzheimers significantly more effective than placebo (p<0.01) in a recent large randomized multicentre study
  - In a meta-analysis of 40 studies, 8 considered high quality and 7 confirmed effectiveness of Ginkgo over placebo in improving function in cerebral insufficiency


Ginkgo Biloba

- Contains 60 known bioactive compounds
- Vascular effects
  - improves peripheral and central blood flow
  - reduces blood viscosity, increases RBC deformability
  - antagonises thromboxane induced vasoconstriction, which has been implicated in Raynauds phenomenon
- Antioxidant effect equivalent to ascorbic acid, glutathione or alpha-tocopherol


Ginkgo Biloba – side effects

- may increase bleeding particularly for those on anticoagulants / antithrombotics
- spontaneous hyphaema reported
- Important to check with GP before considering
Ginkgo Biloba - its role?

- I will recommend Ginkgo for
  - Those wanting a natural therapy for their glaucoma
  - Those with advanced and progressing glaucoma on maximal conventional treatment

Eyebright

- A herbal tablet often mixed with other components
- “Antiseptic, shrinks and soothes inflamed tissues, relieves pain”
- No plausible role in glaucoma or other eye diseases

Bilberry - Huckleberry

- Anthocyanosides used in rhodopsin
- Vit A, Vit C, antioxidants
- Vasodilator and anticoagulant
- For cataract, glaucoma, angina, diabetes, stroke, varicose veins
- “Should be on anyone’s list of herbs for aging”
- No verifiable role for glaucoma
Herbal eyewashes

- Contain: Golden Seal Root, Bayberry Root, Eyebright, Red Raspberry Leaves
- "We have used it in the clinic for eye problems for 7 years now with wonderful results"

At least natural medicines are safe?

- U.S. spends $3.5 billion per year on herbal medicines not including vitamin and mineral supplements
- One in five on prescription meds take herbals too
- 70% do not disclose this to their doctors
- 15 million people may be at risk of interactions
- The ASA has produced a guide for members listing 14 natural medicines that could adversely affect anaesthesia or cause excessive bleeding including Ginseng, Garlic, Ginkgo, St John’s Wort, Echinacea, Ginger

And the annual cost for one recommended natural therapy regimen for glaucoma?

- Bilberry $310
- Eyebright $313
- Co-enzyme Q $412
- Ginger $620
- Chromium $115
- Quercitin $516
- Vitamin B12 $52
- Magnesium $90
- Ginkgo $960
- Coleus $400
- Total Cost $3788