Diagnosis of Glaucoma Progression

Leon W. Herndon MD
Primary Open-Angle Glaucoma
STRUCTURAL DAMAGE PRECEDES FUNCTIONAL CHANGE

- NFL injury can be observed up to 6 years before VF defects\(^1\)
  - Mean number of axons\(^2\) in normal ON
    \(~800,000–1,200,000\)
  - 25-40% of ON fibers can be lost from an eye that retains a normal visual field\(^2,3\)

STRUCTURAL LOSS PRECEDES FUNCTIONAL LOSS

OHTS results show that without optic disc assessment you may be missing up to 55% of glaucoma patients.

- 35% Field change only
- 55% Disc change only
- 10% Both

Disc change precedes VF loss in most cases

How Glaucoma Is Detected
Initial presentation
September 2001

- 60 yo African American Man
- Diagnosed with Glaucoma 4-5 years ago
- No history of eye surgery or laser treatment
- Incarcerated for 3 years after diagnosis
  - Used drops while in prison
  - Stopped when released
- Currently in county jail for 2 months
  - No drops for at least 2 months
History

- Gradual loss of vision left eye
  - Notes worsening vision recently
- Occasional discomfort in both eyes
- Reports being punched in the left eye 20 years ago
- PMHx: HTN (no hypotensive episodes)
  - Meds: Clonidine, Benazapril
- FHx: Mother had glaucoma
**Examination**

- $\text{VA}_{\text{(SC)}}$: 20/20
- HM
- Color: 6/6
- Unable
- Pupils: 6 $\rightarrow$ 3 (brisk)
- 5 $\rightarrow$ minimally reactive
- Marked RAPD OS
<table>
<thead>
<tr>
<th>Examination</th>
</tr>
</thead>
</table>
| • **$T_A$** 18, 17  
  50, 47 |
| • **SLE:** Pterygium nasally OD  
  2+ guttata OS  
  Otherwise Normal |
| • **Gonio:** Open to Scleral Spur 360° OU  
  No sign of angle recession |
| • **Pachy:** 582  
  583 |
FL 1/14
FP 1%
FN 5%
MD -0.68
PSD 1.51
Assessment

• Open angle glaucoma OS>>>OD
• Questionable role of old trauma
• travoprost OU Qhs
• brimonidine OS Q12h
• Plan trabeculectomy OS within one week
Post-operative Course

• Patient is released from Jail
• Post-op week 2 visit
  – Pt leaves clinic without seeing MD
  – Reschedules for 1 week
• Patient disappears
Patient Returns
January 2003

• Blurry vision with “rainbow colors” for the last two months in the right eye
• Moderate pain right eye
• VA 20/60
  HM
• Pupils Marked Left RAPD
• $T_A$ 56
  28
January 2003

- SLE: Pterygium OD; Low bleb OS
  K clear OU
  AC deep and quiet OU
- Gonio: Open to SS for 360° OU
- Treated with acetazolamide, timolol, brimonidine
Follow-up Visit

- No pain right eye
- acetozolamide 500mg BID PO
timolol BID OU
brimonidine BID OU
bimatoprost Qhs OU

VA 20/30
HM

TA 12
10
FL 5/13
FP 1%
FN 0%
MD -29.08
PSD 8.16

DATE: 01-14-2003
TIME: 10:04 AM
AGE: 61
Plan

- Severe Open Angle Glaucoma OU
- Dramatic progression over 1 year
- History of compliance problems
- IOP very good on maximal medical tx
  - Give him another chance?
- Too risky
  - Trabeculectomy scheduled OD ASAP
Post-op

• “My vision is going to get better, right, doc?”
Untreated Field Loss

- Time from early field loss to end-stage field loss
- IOP dependent
  - 20 – 25 → 14.4 years
  - 26 – 30 → 6.5 years
  - >30 → 2.9 years

Jay et al. 1993
Progression Rate, One Patient

Theoretical Rate
1 dB per year

Develops OAG at 40

Duration of Disease

Amount of Damage

MD = 32 at age 75
Clinical trials give best-case scenario for OAG progression rate

- Follow-up aggressively enforced
- Conscious participants in an experiment
- Expert care from glaucoma specialists
- Treatment is often free
- Applies to AGIS, CIGTS, GLT
## Mean OAG Duration by Ethnicity

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Years of OAG</th>
<th>95% C.I.</th>
<th>Worst 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinese</td>
<td>10</td>
<td>[9, 13]</td>
<td>30</td>
</tr>
<tr>
<td>Hispanic</td>
<td>13</td>
<td>[12, 14]</td>
<td>37</td>
</tr>
<tr>
<td>European</td>
<td>13</td>
<td>[12, 14]</td>
<td>38</td>
</tr>
<tr>
<td>African</td>
<td>15</td>
<td>[15, 16]</td>
<td>43</td>
</tr>
</tbody>
</table>

Broman AT, Quigley, HA  IOVS 2008
## Progression rate untreated by ethnicity

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>N</th>
<th>dB/year</th>
<th>95% C.I.</th>
</tr>
</thead>
<tbody>
<tr>
<td>European</td>
<td>375</td>
<td>−1.12</td>
<td>[−1.25, −1.02]</td>
</tr>
<tr>
<td>Hispanic</td>
<td>278</td>
<td>−1.26</td>
<td>[−1.40, −1.12]</td>
</tr>
<tr>
<td>African*</td>
<td>363</td>
<td>−1.33</td>
<td>[−1.48, −1.18]</td>
</tr>
<tr>
<td>Chinese</td>
<td>50</td>
<td>−1.56</td>
<td>[−1.98, −1.18]</td>
</tr>
</tbody>
</table>

* Only African derived is significantly different from European
Glaucoma Progression

- A case–control study recruiting 123 patients with early features of primary open angle glaucoma (control) and 93 patients with advanced glaucoma (cases) was carried out for risk-factor analysis
- Subjects with initial IOP>31mmHg were nearly three times more likely to present with advanced glaucoma than those with IOP<32mmHg
- Subjects over the age of 60 years were more than two times likely to present with advanced glaucoma than younger subjects

## Results:

### Multivariable Modeling

<table>
<thead>
<tr>
<th></th>
<th>AGIS</th>
<th>MD</th>
<th>Vert C/D</th>
<th>Horiz C/D</th>
<th># Meds</th>
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<tbody>
<tr>
<td>CCT</td>
<td>0.001</td>
<td>0.006</td>
<td>&lt;0.001</td>
<td>0.003</td>
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<tr>
<td>Age</td>
<td>--</td>
<td>0.016</td>
<td>--</td>
<td>--</td>
<td>&lt;0.001</td>
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<tr>
<td>Sph Eq</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0.042</td>
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<tr>
<td>IOP</td>
<td>--</td>
<td>0.016</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Gender</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Race</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>FHx</td>
<td>--</td>
<td>--</td>
<td>0.011</td>
<td>0.042</td>
<td>0.032</td>
</tr>
</tbody>
</table>
How fast does OAG progress after there is already field loss?

4% of treated glaucoma subjects have worse field per year of follow-up

Smith, Katz, Quigley. IOVS 1996
So, on average:

4% worse per year times 15 years duration =

60% of treated glaucoma patients are likely to worsen (measurably) in their lifetimes
Progression Pearls

- You can’t judge progression from 2 fields (or 3 or even 4 sometimes)
- Always repeat the field to confirm a change before instituting a change in management
- If you can’t decide, start a series of fields, one every 3 months until the pattern is clear
- Use the disc and NFL findings to confirm