Early Detection Of Glaucoma – Clinical Clues

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Points To Live By

• 25% of G pxs NEVER have IOP > 21mm
• 50% of G pxs have trough IOP < 21mm
• Glaucoma effects ONH in characteristic patterns
• ONH damage occurs well before VF changes appear
• Disk evaluation remains the most effective method of diagnosing glaucoma

Glaucoma Risk Factors

• FINDACAR

• The more risk factors one has, the more likely one is to develop glaucoma

• The more risk factors one has, the lower the IOP target should be
A Review Of Risk Factors

• FINDACAR
  – Family history
  – IOP
  – Nearsightedness
  – Diabetes/Vascular disease
  – Age
  – Corneal thickness
  – Asymmetry
  – Race

A risk factor analysis is critical

• For the diagnosis
• To increase your level of suspicion
• For initiating therapy
• For changing therapy

• BUT...are any of these more important than others?

Characteristics of Normal Disk

• Vertical dimension = 2mm
• Avg disk = 10-12 vessel widths
• Avg disk = middle spot size
• Avg C/D = .4/.4
• Cup size correlates with disk size
• Symmetry between 2 eyes
Characteristics of Normal Disk
part 2

• Neuroretinal rim equal superiorly and inferiorly
• Temporal rim is thinnest
• ISNT Rule of Jonas
• Rim color – pink & symmetrical
• REMEMBER: C/D has a horizontal and vertical component

Normal Disk Variations

• Normal disk varies between .8mm2 – 6mm2
• Myopes have larger disks
• Hyperopes have smaller disks
• African-Americans have largest normal disks
• Size Does Matter!

Pathologic Changes Due To Glaucoma

• Thinning of neuroretinal rim
• Deepening of optic cup
• NFL atrophy
• Increase cupping
• Splinter hemes
• PPA (Peripapillary atrophy)
• Vessel changes
Glaucomatous ONH Characteristics

- ONH asymmetry
- NFL dropout
- Neuroretinal rim defects
  - Focal notches
  - Loss of rim area
  - Sharp rim
- C/D ratio
- Lamina cribrosa
- Alpha & Beta zones

3-D Model: Normal vs Glaucoma

The 3-D model undergoes specific patterns of change as a result of glaucomatous damage

- RNFL surface becomes flatter
- cup becomes larger
- slope steeper
- depth greater

Why do these pathologies occur?

- Pressure induced
- Ischemia
- Poor autoregulation
- Microcirculation dysfunction
- Glutamate toxicity
Neuroretinal Rim

• What is it?
• ISNT Rule of Jonas
• In glaucoma the rim thins:
  – Sup/temp & inf/temp 1st
  – Temporal next
  – Nasal last remnant
• Can recede focally or globally
• Look at the donut, not the hole!

Nerve Fiber Layer Atrophy

• Bright/Dim/Bright Pattern
• Obscures view of underlying vessels
• How to best view?
  – Hi mag
  – Bright illumination
  – Red free filter

Increase C/D

• Ophthalmoscopic manifestation of neuroretinal rim thinning
• Early sign of progression
• Verticalization
• Cup shape should not necessarily be the same as disk shape
Deepening of Optic Cup

- Visible laminar dots
- Size of pores important
- Correlation w/ VF
- Slope changes
- Bean potting
- Excavation is sign of progression
- Bean potting
- Excavation is sign of progression

Peripapillary Atrophy and Glaucoma

- Zone alpha, zone beta
- More frequent in NTG & POAG than in normals or OHTN
- Correlation between degree of PPA and optic disk damage
- Correlation between location of atrophy and location of disk damage and corresponding VF loss
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Zone alpha, zone beta

- The larger the area of atrophy:
  - Increased MD
  - Decreased MS
- Size correlates with:
  - Neuroretinal rim area
  - C/D
  - NFL thickness
  - VF loss
- Pathogenesis: ischemia of peripapillary choroidal circulation; vascular deficiency
OHTS

• Goal of tx – 20% drop in IOP
  - 24mm target IOP

RESULTS: At 5 years
  4.4% of tx group developed POAG
  9.5% of no tx group developed POAG
So lowering IOP in Oc Hx reduced the likelihood of glaucoma by 50% - RIGHT?

OHTS – A Closer Look

• 90% of untreated group did not progress
• 95.6% of tx group did not progress

• It proved that *in those individuals who are going to progress* to POAG lowering IOP by 22.4% will delay the onset by at least 5 yrs.
• Who are "those individuals at risk"?

OHTS – The Nitty Gritty

• The most predictive factors for conversion:
  – Older age
    • 22% increase/ decade
  – Larger horizontal and vertical C/D
    • 32% increase/0.1 larger
  – Higher baseline IOP
    • 10% increase/ mm Hg
  – Thinner corneas
    • 71% increase in risk/ 40 microns thinner
Risk Factors For Conversion

The pachymetry issue

- **Juicy Data**
  - 36% of pxs w/ IOP >25.75 AND K thickness < 555 microns developed POAG
  - 6% of pxs w/ same IOP but K thickness > 588 converted toPOAG
- **Juicy Data II**
  - 15% pxs w/ C/D .3/.3 and K thickness < 555 microns converted but
  - 4% of pxs w/ same disk parameters and K thickness> 588 microns converted

More Pachymetry Chatter

- African-Americans have thinner corneas
- Perhaps thin corneas translate to poor connective tissue at the disk as well
- Is there a fudge-factor for K thickness?
  - Baseline of 545 microns
  - Add or subtract 2.5mm Hg for every 50 microns deviation (Doughty and Zaman, Surv Ophthalmol, 2000).
- How should you use this data?
Corneal Thickness And Glaucoma
The Latest Scoop

- CCT and VF loss —
  - CCT is a strong predictor for field loss in both NTG and POAG
  - CCT-adjusted IOP does not predict VF loss

Corneal Thickness and Glaucoma

- CCT and Visual Function In OHT pxs
  - OHT pxs with abnormal SWAP results had significantly thinner CCT than normals or OHT pxs with no VF defects
    - Abnormal VF – 545microns
    - OHT w/ normal VF – 572 microns
    - Normals – 557 microns
    - Medeiros, Sample, Weinreb – AJO Feb, 2003 135,No.2

- So????

CCT And Glaucoma- More latest scoop

- RNFL thickness and CCT in OHT pxs
  - RNFL in OHT pxs with CCT < 555 was significantly thinner than in those with CCT >555.
  - RNFL of normals and OHT pxs with CCT >555 were similar
  - Points to an inherent structural predisposition to glaucomatous damage?
Visual Fields and Glaucoma

• Are they still cool?
• Are they considered the standard of care?
• How often?
• Do they better measure early detection or progression?

Are certain VF parameters more predictive for progression?
• Johnson, Sample et al. – AJO 8/2002 177-185
• Highest predictors of conversion
  – GHT “outside normal limits”
  – 2 hemifield clusters worse than 5% level
  – 4 abnormal (P<.05) locations on pattern deviation probability plot
  – Specificity increased with 2nd confirmatory VF test

FIGURE 1. Representation of the point clusters that comprise the glaucoma hemifield test segments.
Which VF instrument is best?

- SAP, SWAP or FDT
  - FDT and SWAP similar in flagging abnormal locations
  - FDT defects were more extensive in 62%
- SWAP more specific and accurate than SAP but harder to administer
- FDT questionable in end stage glaucoma
- Use 10-2 strategy in advanced glaucoma

Heidelberg Edge Perimeter (HEP)

- New “Flicker Defined Form” Stimulus
- Overcomes limitations in Frequency Doubling Technology
- Targets M-cell visual pathway

What About Imaging Units?

- Are they essential?
- What do they do?
- What do they don’t do?
- Are they the standard of care?
3 Questions For The Audience:

1. What is your definition of glaucoma?

2. What is the pathology of glaucoma?

3. Is retinal imaging the standard of care for treating glaucoma?

RNFL and Glaucoma

Glaucoma is a disease of the RNFL

- Axons of retinal ganglion cells form the retinal nerve fiber layer (RNFL)
- Glaucoma is characterized by loss of ganglion cells leading to loss of retinal nerve fibers

RNFL and Glaucoma

- RNFL changes are early to occur in glaucoma
- Up to 50% of the retinal nerve fibers may be lost before a visual field defect is detectable
- Early detection of glaucoma by RNFL imaging and analysis leads to early treatment, improving the chance to delay or halt the disease progression
3 Phases of Glaucoma and Retina Patient Care

1. **ASSESS** – Risk Assessment at Initial Visit

2. **DIAGNOSE** – Moving past “suspect”

3. **MANAGE** – Track progression & monitor treatment

It’s Like An Alphabet Soup!!!

- GDx
- HRT
- OCT
- Optovue

- Are they all the same?
- Are they all different?
- Are there clinical studies to prove their claims?

IOP and Glaucoma

- Which IOP is most important?
  - Mean IOP
  - Peak IOP
  - Trough IOP
  - IOP range

- Are we measuring it correctly?
• For pxs who showed progression of glaucoma despite IOP at acceptable range
  – 3% showed a peak IOP >21mm
  – 35% showed a range of IOP >5mm
    – Collaer, Caprioli, et.al, J Glaucoma 2005;14(3): 196-200

• Underscores the importance of serial tonometry even in well controlled pxs

When Is The Peak IOP?

• 3,025 IOP readings on 1,072 eyes
• NTG, POAG, Pre-perimetric G, OHT

• Results:
  – Peak IOP – 7AM – 20.4%
  – Noon – 17.8%
  – 5PM - 13.9%
  – 9PM – 26.7%

Jonas study conclusion

• “Any single IOP measurement taken between 7AM and 9PM has a higher than 75% chance to miss the highest point of the diurnal curve.”

• Stresses the need for serial tonometry.