SUSPECTING GLAUCOMA

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Orlando, Florida

NO FINANCIAL DISCLOSURES.

SUSPECT EVERYONE

“…WE RECOMMEND THAT EVERY COMPLETE OCULAR EXAMINATION BE PERFORMED WITH THE POSSIBILITY OF GLAUCOMA FIRMLY IN MIND…”

Drs. Hodapp, Parrish and Anderson
Clinical Decisions in Glaucoma
1993, Mosby

and again in
Drs. Chang, Ramulu and Hodapp
Clinical Decisions in Glaucoma
THAT SEEMS EXCESSIVE BUT IS IT?

STATISTICS

• WORLD WIDE
  • GLAUCOMA AFFECTS > 45 MILLION
  • OAG AND ANGLE CLOSURE ARE 2ND LEADING CAUSE OF BILATERAL BLINDNESS (CATARACTS)
  • 8.4 MILLION PEOPLE ARE BILATERALLY BLIND FROM IT
    • ~ 4.5 MILLION OAG
    • ~ 3.9 MILLION ACG

• UNITED STATES
  • 3.36 MILLION WITH OAG BY 2020
  • OVERALL PREVALENCE OF POAG FOR ADULTS > 40 YO = 2% (2004)
  • OAG 7X MORE PREVALENT THAN ACG
  • 50% WITH ONH DAMAGE ARE UNAWARE
KNOW YOUR PATIENT POPULATION

<table>
<thead>
<tr>
<th>TABLE IV. Frequency of Nonrefractive Ocular Diagnoses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosis</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Glaucoma</td>
</tr>
<tr>
<td>Suspect</td>
</tr>
<tr>
<td>Primary Open Angle</td>
</tr>
<tr>
<td>Angle Closure</td>
</tr>
<tr>
<td>Pseudophakic</td>
</tr>
<tr>
<td>Traumatic</td>
</tr>
<tr>
<td>Diabetes</td>
</tr>
<tr>
<td>No Retinopathy</td>
</tr>
<tr>
<td>Nonproliferative</td>
</tr>
<tr>
<td>Macular Edema</td>
</tr>
<tr>
<td>Proliferative</td>
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<tr>
<td>AMD</td>
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<tr>
<td>Nontoxicative</td>
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<tr>
<td>Drusen</td>
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<tr>
<td>Exudative</td>
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<tr>
<td>Other</td>
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<tr>
<td>Pigmentary Glaucoma</td>
</tr>
<tr>
<td>Cataract</td>
</tr>
<tr>
<td>Retinal Vascular Disease</td>
</tr>
<tr>
<td>Severe Dry Eye</td>
</tr>
<tr>
<td>Optic Neuritis</td>
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<tr>
<td>Peripheral Retinal Disease</td>
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</tbody>
</table>

VETERAN EYE DISEASE AFTER ELIGIBILITY REFORM: PREVALENCE AND CHARACTERISTICS

Military Medicine, 178, 7:811, 2013

WHAT’S THE DIFFERENCE BETWEEN HAVING GLAUCOMA AND BEING A SUSPECT?

<table>
<thead>
<tr>
<th>TABLE II. Diagnoses in Veterans in the Veterans Affairs Capital Health Care Network from Fiscal Year 2007 to Fiscal Year 2011</th>
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<tbody>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>Disease category, n (%)</td>
</tr>
<tr>
<td>Disorders of refraction and accommodation</td>
</tr>
<tr>
<td>Glaucoma</td>
</tr>
<tr>
<td>Ophthalmic complications of diabetes</td>
</tr>
<tr>
<td>Cataract</td>
</tr>
<tr>
<td>Any ophthalmic diagnosis</td>
</tr>
</tbody>
</table>

TRENDS IN PREVALENCE OF DIAGNOSED OCULAR DISEASE AND UTILIZATION OF EYE CARE SERVICES IN AMERICAN VETERANS

Military Medicine, 178, 7:811, 2013
PRIMARY OPEN-ANGLE GLAUCOMA

“A CHRONIC, PROGRESSIVE OPTIC NEUROPATHY IN ADULTS IN WHICH THERE IS A CHARACTERISTIC ACQUIRED ATROPHY OF THE OPTIC NERVE AND LOSS OF RETINAL GANGLION CELLS AND THEIR AXONS. THIS CONDITION IS ASSOCIATED WITH AN OPEN ANTERIOR CHAMBER ANGLE BY GONIOSCOPY.”

AMERICAN ACADEMY OF OPHTHALMOLOGY
Preferred Practice Pattern
2015

GLAUCOMA SUSPECT

• “SOMEONE WHO, FOR ONE OR MORE REASONS, IS AT HIGHER THAN USUAL RISK OF DEVELOPING GLAUCOMATOUS OPTIC NERVE DAMAGE AND VISUAL DEFICIENCY AND THEREFORE WARRANTS CAREFUL FOLLOW-UP.”

• “AN INDIVIDUAL WITH CLINICAL FINDINGS AND / OR A CONSTELLATION OF RISK FACTORS THAT INDICATE AN INCREASED LIKELIHOOD OF DEVELOPING PRIMARY OPEN-ANGLE GLAUCOMA.”
RISK FACTORS ASSOCIATED WITH OPEN-ANGLE GLAUCOMA

• NUMEROUS STUDIES IDENTIFY THESE
  • HIGHER IOP
  • OLDER AGE
  • FAMILY HISTORY OF GLAUCOMA
  • AFRICAN RACE OR LATINO / HISPANIC ETHNICITY
  • THINNER CENTRAL CORNEA
  • LOW OCULAR PERFUSION PRESSURE
  • TYPE 2 DIABETES MELLITUS
  • MYOPIA
  • LOWER SYSTOLIC AND DIASTOLIC BLOOD PRESSURE
  • DISC HEMORRHAGE
  • LARGER CUP-TO-DISC RATIO
  • HIGHER PSD ON THRESHOLD VISUAL FIELD

• OTHER FACTORS
  • MIGRAINES / PERIPHERAL VASOSPASM
  • SYSTEMIC ARTERIAL HYPERTENSION
  • TRANSLAMINAR PRESSURE GRADIENT
  • GENETICS

AGE

• PREVALENCE OF GLAUCOMA
  • INCREASES WITH AGE
  • FRAMINGHAM EYE STUDY
    • PREVALENCE OF POAG
      • 52-85 YO = 1.65%
      • IF YOU ADD VF TESTING = 2.1%
  • OVERALL PREVALENCE
    • 4-10X HIGHER IN OLDER AGE GROUPS COMPARED TO THOSE IN 40S
    • 2004 DATA
      • 2% OF POPULATION > 40 YO HAD POAG

TABLE 1  PREVALENCE (%) OF DEFINITE OPEN-ANGLE GLAUCOMA

<table>
<thead>
<tr>
<th>Study</th>
<th>Age Groups (yo)</th>
<th>40-45</th>
<th>50-55</th>
<th>60-69</th>
<th>70-79</th>
<th>80+</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>bulbomax et al.</td>
<td></td>
<td>1.3</td>
<td>4.2</td>
<td>6.2</td>
<td>6.9</td>
<td>12.5</td>
<td>5.0</td>
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<tr>
<td>surbey et al</td>
<td></td>
<td>1.4</td>
<td>4.1</td>
<td>6.7</td>
<td>8.8</td>
<td>19.6</td>
<td>3.6</td>
</tr>
<tr>
<td>los angeles latino et al</td>
<td></td>
<td>1.3</td>
<td>4.9</td>
<td>7.4</td>
<td>19.7</td>
<td>21.0</td>
<td>4.7</td>
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<td>project vision evaluation study</td>
<td></td>
<td>0.5</td>
<td>0.6</td>
<td>1.7</td>
<td>5.7</td>
<td>10.6</td>
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<tr>
<td>bulbomax et al.</td>
<td></td>
<td>0.2</td>
<td>0.3</td>
<td>1.5</td>
<td>2.3</td>
<td>1.94</td>
<td>1.4</td>
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<tr>
<td>blue mountains et al</td>
<td></td>
<td>0.4</td>
<td>1.3</td>
<td>4.7</td>
<td>11.4</td>
<td>30.0</td>
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<tr>
<td>visual impairment project</td>
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<td>0.5</td>
<td>1.5</td>
<td>4.6</td>
<td>8.6</td>
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<tr>
<td>reuter east eye study</td>
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<td>0.7</td>
<td>1.8</td>
<td>2.2</td>
<td>3.1</td>
<td>4.9</td>
<td>1.5</td>
</tr>
</tbody>
</table>
**RACE**

- **AFRICAN AMERICANS**
  - Develop disease earlier
  - Do not respond as well to treatment
  - More likely to require surgery
  - Higher prevalence of blindness
  - **Baltimore Eye Survey**
    - Prevalence of glaucoma
    - AA were 4.3X CAUCASIANS

- **AFRO-CARIBBEAN**
  - Barbados Eye Study
  - Higher than AA > 60 YO

<table>
<thead>
<tr>
<th>Study</th>
<th>Ethnic Group</th>
<th>40-69</th>
<th>70-79</th>
<th>80+</th>
<th>Total</th>
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<tbody>
<tr>
<td>Baltimore Eye Study</td>
<td>Hispanic-American</td>
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<tr>
<td>Los Angeles Latino Eye</td>
<td>Latino</td>
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<tr>
<td>Study</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Prince George Evaluation</td>
<td>Latinos</td>
<td>0.5</td>
<td>0.0</td>
<td>1.7</td>
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<tr>
<td>Baltimore Eye Study</td>
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<td>0.2</td>
<td>0.0</td>
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<td>2.3</td>
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<td>Eye Mountains Eye Study</td>
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<td>0.2</td>
<td>0.4</td>
<td>1.3</td>
<td>1.9</td>
</tr>
<tr>
<td>Visual Impairment Project</td>
<td>N/R</td>
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<td>1.5</td>
<td>4.5</td>
<td>6.6</td>
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<td>Downtown Dari Eye Study</td>
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<td>0.0</td>
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<td>Etiopocentric</td>
<td>N/R</td>
<td>0.1</td>
<td>0.0</td>
<td>0.7</td>
<td>0.8</td>
</tr>
</tbody>
</table>

- **LATINO / HISPANIC ETHNICITY**
  - Prevalence
    - Increases with age
    - > 40 YO 1.7% > 80 YO 7.4%
  - Starting at age 60
    - ≥ AFRICAN AMERICANS

- **OTHER RACES**
  - Japanese
    - Higher prevalence of normal tension glaucoma
  - Chinese, Vietnamese, Pakistani, Inuit
    - Higher prevalence of angle closure glaucoma
**DIABETES**

**CONFLICTING REPORTS**
- Some studies find no relationship
- Others say DM is protective
- Others say DM is risk factor for POAG

**POPULATION BASED STUDIES**
- Higher odds of DM with POAG
  - 40% higher odds in Hispanics
  - 2x higher in nonHispanic whites
  - Longer duration of type 2 = higher risk of having POAG
- Meta-analysis of 47 studies
  - Increased risk of glaucoma and may be associated with elevated IOP

**MECHANISM THEORY**
- Microvascular changes may make ONH more susceptible to damage in those with type 2 DM

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**OCULAR PERFUSION PRESSURE** and BP

**OCULAR PERFUSION PRESSURE**
- Difference between BP and IOP
  - Systole or diastole

**MECHANISM THEORY**
- Reduced perfusion and/or vascular dysregulation and the subsequent ischemia of the ONH contribute to glaucoma damage

**HOW TO CALCULATE IT**
- Mean OPP = 2/3 MAP - IOP
  - Mean arterial pressure (MAP) = DBP + [1/3 X (SBP-DBP)]
- It is not exact

**SHOULD WE BE CALCULATING IT?**
- Things other than IOP impact glaucoma
- Check blood pressure
- Low BP with high IOP = at risk (lower OPP)
  - Risk of reduction in volume of blood to ONH
  - Eyes at risk due to impaired autoregulation
  - Risk of ischemia, oxidative stress
FAMILY HISTORY

• ROTTERDAM EYE STUDY
  • ALL SIBLINGS OF GLAUCOMA CASES AND CONTROLS EVALUATED
    • ODDS OF POAG WERE 9.2X HIGHER IF FIRST DEGREE RELATIVE WITH POAG
      • FIRST DEGREE = SIBLING OR PARENT
  • BALTIMORE EYE SURVEY AND LALES
    • ODDS OF POAG 1.92 AND 2.85 IF FIRST DEGREE RELATIVE
    • ODDS OF 3.7 AND 3.47 IF SIBLING WITH GLAUCOMA
    • 5X HIGHER IF TWO OR MORE SIBLINGS

THE EYE EXAM AND...
OPPORTUNITIES TO SUSPECT GLAUCOMA

• VA
• PUPILS
• SLIT-LAMP
• IOP
• CENTRAL CORNEAL THICKNESS
• GONIOSCOPY

• DILATED FUNDUS EVALUATION
• MAGNIFIED, STEREOSCOPIC EVALUATION OF
  • ONH
  • RNFL
• DOCUMENTATION OF ONH
  • STEREOPHOTOGRAPHY
  • OR
  • COMPUTER BASED ANALYSIS
• VISUAL FIELD BY AUTOMATED PERIMETRY
REFRACTIVE ERROR

- MYOPIA
  - 1999 BLUE MOUNTAINS STUDY (AUSTRALIA)
    - 3654 PATIENTS
    - GLAUCOMA DIAGNOSED BASED ON VISUAL FIELDS, OPTIC DISC CUPPING, RIM THINNING
    - GLAUCOMA PRESENT IN
      - 1.5% NO MYOPIA, 4.2% OF LOW MYOPIA (1-3D), 4.4% MODERATE-HIGH MYOPIA (>3D)
  - CONCLUSIONS
    - 2-3X GREATER RISK IF MYOPIC, INDEPENDENT OF OTHER GLAUCOMA RISK FACTORS AND IOP

- LALES
  - LONGER AXIAL LENGTH HAS HIGHER PREVALENCE OF POAG

- POSSIBLE MECHANISM
  - WEAKER SCLERAL SUPPORT AT ONH = GREATER SUSCEPTIBILITY OF OPTIC NERVE TO DAMAGE

- HYPEROPIA
  - RISK OF ANGLES BEING NARROW
  - CONSIDER GONIOSCOPY

PRELIMINARY TESTING

- VISUAL STATUS
  - POSSIBLY NORMAL OR
    - 20/20 OR REDUCED DUE TO SEVERE GLAUCOMA
    - OR AMBLYOPIA OR OTHER DISEASE

- LENSOMETRY / AUTOREFRACTION
  - POSSIBLY EMMETROPIA OR
    - AXIAL MYOPES
      - SUSCEPTIBLE TO ONH DAMAGE
    - HYPEROPE
      - RISK OF NARROW ANGLES

- PUPILS
  - POSSIBLY NORMAL OR
    - APD POSSIBLE IF ASYMMETRIC GLAUCOMA
      - OR OTHER DISEASE
    - MID-DILATED IF ACUTE ANGLE CLOSURE
    - SURGICAL
      - LOOK FOR BLEB

- CONFRONTATION FIELDS
  - POSSIBLY NORMAL OR
    - CONstricted
      - INF NASAL OR 360 DEGREES
      - GLAUCOMA OR OTHER DISEASE
SLIT LAMP EXAMINATION

• CONJUNCTIVA / SCLERA
  • POSSIBLY NORMAL OR…
    • HYPEREMIA
      • POSSIBLE SIGN OF INFLAMMATION
      • ? UVEITIC
      • ON PROSTAGLANDIN OR OTHER
    • SCARRING
      • ? H/O FAILED SURGERY
  • OTHER INDICATORS
    • TUBE PLATE
    • SUTURES
    • FILTRATION BLEB

SLIT LAMP EXAMINATION

• CORNEA
  • POSSIBLY NORMAL OR…
    • SCARRING
    • PIGMENT
      • KRUKENBERG SPINDLE
    • KERATIC PRECIPITATES
    • EDEMA
      • IF PRESSURE HIGH
    • GUTTATA
      • MAY THROW OFF IOP READING
    • WHORL KERATOPATHY
      • MAY BE ON RHO-KINASE INHIBITOR
SLIT LAMP EXAMINATION

• IRIS
  • NORMAL OR…
    • TRANSILLUMINATION DEFECTS
    • WHITE FLAKES AT PUPILLARY BORDER
    • SPHINCTER TEARS
    • HETEROCHROMIA
    • KOEPPE OR BUSACCA NODULES
    • IRIDECTOMY / IRIDOTOMY
    • NEOVASCULARIZATION
      • RARE IF ASYMPTOMATIC
    • DEVELOPMENTAL ABNORMALITIES
      • ICE SYNDROMES (UNILATERAL)
      • AXENFELD-REIGER’S (BILATERAL)

• ANTERIOR CHAMBER
  • NORMAL OR…
    • CELLS AND / OR FLARE
      • ACTIVE INFLAMMATION
    • SYNECHIAE
      • PRIOR INFLAMMATION
    • TUBES / EXPRESS SHUNT
    • ACIOL
      • COMPLICATED CATARACT
      • COMBINED PROCEDURE
    • MIGS ?
      • WILL NEED GONIO LENS TO VI
  • ESTIMATE DEPTH
    • < GRADE 2, DO GONIOSCOPY
ESTIMATE ANGLE DEPTH

GONIOSCOPY

• WHY DO IT?
  • IS IT SAFE TO DILATE?
    • DONE IF < GRADE 2 ON VAN HERICK
    • CONSIDER ON ALL > +2.50
  • DIFFERENTIATE
    • OPEN VS ANGLE CLOSURE GLAUCOMA
      • IF NARROW, MAY INFLUENCE TREATMENT OPTIONS
    • PRIMARY OPEN ANGLE VS SECONDARY OPEN ANGLE
      • IF SECONDARY, MAY INFLUENCE TREATMENT OPTIONS
  • MONITOR FOR CHANGE
  • ANGLE CLOSURE SUSPECT
    • IF < 180 DEGREES OF VISIBLE TM (POSTERIOR/PIGMENTED)

<table>
<thead>
<tr>
<th>TABLE 1</th>
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<tbody>
<tr>
<td>Original van Herick grading scale</td>
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<tr>
<td>Van Herick's grading</td>
</tr>
<tr>
<td>Grade 1</td>
</tr>
<tr>
<td>Grade 2</td>
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<tr>
<td>Grade 3</td>
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<tr>
<td>Grade 4</td>
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</table>
GONIOSCOPY DOCUMENTATION

- Several grading systems can be used
  - Shaffer, Spaeth, Scheie (1957)
  - 4-mirror is preferred
- What to look for
  - Mentally note
    - Open, suspiciously narrow
    - Asymmetric differences
  - Record the depth
    - Most posterior structure visualized in all quadrants OD / OS
    - If narrow, does angle open with compression?
  - Record presence / absence of
    - Pigment, PAS, recession, NV

NORMAL VS ABNORMAL GONIOSCOPY

Cymbor, M. Review of Optometry. October 15, 2016
PDS / PIGMENTARY GLAUCOMA

- KRUKENBERG SPINDLE AND/OR IRIS TRANSILLUMINATION DEFECTS (SPOKE-LIKE, MID-PERIPHERAL)
- DARKLY PIGMENTED POSTERIOR TM ON GONIO
- MIDPERIPHERAL POSTERIOR IRIS BOWING
- TRANSIENT EPISODES OF BLURRED VISON OR SEEING HALOS AROUND LIGHTS AFTER EXERCISE
- MODERATELY MYOPIC MEN < AGE 50
- MAPPED TO CHROMOSOME 7q35-q36 (GPDS1 GENE)
- IOP MAY SPIKE
  - OBSTRUCTION OF TRABECULAR MESHWORK BY PIGMENT AND PIGMENT-LADEN MACROPHAGES
- GLAUCOMA MAY DEVELOP IN 25-50% WITH PDS

PSEUDOEXFOLIATION / GLAUCOMA

- GRAY-WHITE MATERIAL DEPOSITION ON PUPIL MARGIN, ANTERIOR LENS CAPSULE OR CORNEAL ENDOTHELIUM
  - ALSO FOUND IN SKIN, HEART, LUNGS
- LOSS OF PUPILLARY RUFF, TRANSILLUMINATION DEFECTS
- PIGMENTED TM AND SAMPARESI’S LINE
- WHITE MATERIAL ON ZONULES
- BILATERAL > UNILATERAL, ASYMMETRIC
- RARELY < AGE 65
- IOP MAY SPIKE
  - FROM ACCUMULATION OF MATERIAL IN ANGLE OR LENTICULAR PUPILLARY BLOCK FROM ZONULAR LAXITY AND MOVEMENT OF LENS
- 60% MAY DEVELOP OC HTN OR GLAUCOMA
INTRAOCULAR PRESSURE

- A RISK FACTOR ONLY
  - NOT PART OF THE DEFINITION
- PREVALENCE OF GLAUCOMA INCREASES WITH LEVEL OF IOP
- THE HIGHER THE IOP, THE GREATER THE RISK AND SEVERITY OF GLAUCOMA
- RISK OF DEVELOPING GLAUCOMA
  - IOP > 21 mmHg 16X RISK VS < 16 mmHg
- DEVELOPING VF DEFECT OVER 5 YEARS
  - 6.7% IF IOP > 20 mmHg
  - 1.5% IF IOP < 20 mmHg


INTRAOCULAR PRESSURE

- WORRIED ABOUT THE IOP > 21mmHg?
  - THAT NUMBER IS ARBITRARY
    - 2 STANDARD DEVIATIONS ABOVE THE MEAN IN THE EUROPEAN POPULATION
- WHAT IF THE IOP IS NOT “HIGH”?
  - IT DOES NOT MATTER
    - BALTIMORE EYE SURVEY
      - 55% NEWLY DIAGNOSED POAG HAD INITIAL IOP < 22 mmHg
      - 24% < 22 mmHg ON TWO READINGS
      - 16% < 22 mmHg ON THREE READINGS
INTRAOCULAR PRESSURE

• ≥ 22 mm Hg = FURTHER TESTING RECOMMENDED

• IF IOP IS NOT ELEVATED
  • NO GUARANTEE OF NORMALCY

• IF IOP IS ELEVATED
  • GOAL IS TO FIND THE CAUSE
  • POAG IS A DIAGNOSIS OF EXCLUSION
  • THE CAUSE WILL INFLUENCE TREATMENT OPTIONS

• IF IOP IS ASYMMETRIC
  • NORMALS RARELY DIFFER BY 2 mmHg
  • POAG MAY HAVE MODERATE ASYMMETRY
  • IF WIDELY DISPARATE, CONSIDER UNILATERAL PROCESS (SECONDARY CAUSE)
    • PSEUDOEXFOLIATION, TRAUMA, ETC.

INTRAOCULAR PRESSURE

• HOW MANY IOP READINGS SHOULD I GET?
  • AT LEAST 3 READINGS, ON DIFFERENT DAYS, AT DIFFERENT TIMES OF THE DAY

• WHAT DEVICE SHOULD I USE?
  • APLANATION PREFERRED FOR MANAGEMENT
  • NCT / TONOPEN / ACCEPTABLE FOR SCREENING
    • NOT AS ACCURATE / REPEATABLE FOR HIGH AND LOW IOP
  • OTHER OPTIONS
    • ICARE, ORA, DCT, ETC.
  • BE CONSISTENT
  • TRAIN TECHNICIANS WELL, REPEAT AS NEEDED

• RECORD TIME TESTED
  • CONSIDER MODIFIED DIURNAL TESTING
INTRAOCULAR PRESSURE

• BUT…
  • SUSCEPTIBILITY OF OPTIC NERVE DAMAGE VARIES
  • 3-6 MILLION PEOPLE HAVE OCULAR HYPERTENSION WITHOUT GLAUCOMATOUS DAMAGE

FROM THE OHTS

• 1300 PATIENTS
• RESULTS
  • IOP RELATED INFO
    • LOWERING IOP DELAYS OR PREVENTS DEVELOPMENT OF GLAUCOMA IN PATIENTS WITH ELEVATED IOP
    • MAJORITY OF OCULAR HTN PATIENTS DO NOT DEVELOP GLAUCOMA
    • ALL PATIENTS WITH OCULAR HTN DO NOT NEED TREATMENT
    • TREAT THOSE AT GREATEST RISK

FROM THE OHTS
- 1300 PATIENTS
- RESULTS
  - CCT RELATED INFO
    - INFLUENCES GOLDMANN TONOMETRY
    - A RISK FACTOR FOR DEVELOPING POAG
      - THICKNESS < 555 um 3X RISK COMPARED TO > 588
    - RISK FACTOR FOR PROGRESSION?
      - NOT ALL STUDIES AGREE
      - STILL TO BE DETERMINED

CENTRAL CORNEAL THICKNESS
- RACIAL VARIATIONS ARE PRESENT
  - AFRICAN AMERICAN 534 um
  - LATINO 546 um
  - CAUCASIAN 556 um
- SAY NO TO NOMOGRAMS
- THINK: THIN / NORMAL / THICK
  - THIN = AT RISK

“THE IMPLICATION THAT IOP CAN BE CORRECTED WITH AN ARITHMETIC, LINEAR CORRECTION FACTOR OF SOME mmHg / um CLEARLY REPRESENTS AN OVERSIMPLIFICATION OF WHAT IS UNDOUBTEDLY A COMPLEX AND NONLINEAR RELATIONSHIP BETWEEN CORNEAL THICKNESS AND TRUE IOP”

BRANDT JD, ET AL
OHTS, OPHTHALMOLOGY 2001; 108: 1779-1788
SLIT LAMP EXAMINATION

- Lens Assessment (Typically Once Dilated)
  - Normal or
    - Pigment
      - Trauma, posterior synechiae
    - Pseudoexfoliation
    - Subluxation
    - Cataract
      - Rosette
      - Phacolytic
      - Phacomorphic
    - Pseudophakic
      - Uneventful?
      - Complicated?
      - ? Pseudoexfoliation vs Other

FUNDUS EXAMINATION

- Normal or
  - Possible Reasons for VF Defect
    - Artery / Vein Occlusion
    - Other Retinal Lesions
    - Other Optic Neuropathies
    - S/P PRP
  - Possible Secondary Glaucoma
    - Trauma
      - Chorioretinal Scar
      - Choroidal Rupture
      - Macular Hole
      - Retinal Tear / RD
    - NVG
      - Vascular Occlusion
      - OIS
      - Sickle Cell
CLINICAL FINDINGS CHARACTERISTIC OF POAG

• **OPTIC DISC** STRUCTURAL ABNORMALITIES

• **RETINAL NERVE FIBER LAYER** STRUCTURAL ABNORMALITIES

• RELIABLE AND REPRODUCIBLE **VISUAL FIELD** ABNORMALITY

WHAT’S THE FIRST THING WE NOTICE WHEN LOOKING AT THE OPTIC NERVE?
THE C/D RATIO

“WHEN A CLINICIAN EXAMINES A PATIENT FOR THE FIRST TIME, THERE IS NO WAY TO DETERMINE WHETHER THE C/D RATIO OBSERVED HAS BEEN STABLE DURING THE PATIENT’S LIFETIME OR HAS ENLARGED AS PART OF THE DISEASE PROCESS, ASSUMING THAT NO PREVIOUS PHOTOGRAPHS OR MEASUREMENTS ARE AVAILABLE FOR COMPARISON”

GORDON MO, ET AL.
THE OHTS: BASELINE FACTORS THAT PREDICT THE ONSET OF POAG
ARCH OPHTHALMOL 2002; 120: 701-713.

GO BEYOND THE C/D

• WHY?
  • NO LINE SEPARATING NORMAL FROM GLAUCOMA
  • NORMAL VERTICAL C/D RATIO VARIES FROM 0.00-0.85
  • C/D RATIO OF ≥ 0.65 OCCURS IN 2.2 - 4% OF NORMALS
  • C/D RATIO IS A FUNCTION OF DISC DIAMETER

• REMEMBER
  • LOOK AT THE CONTOUR OF THE CUP, NOT THE COLOR

• DOCUMENT WHAT YOU SEE, NOT JUST THE C/D
  • DESCRIBE THE ONH
OPTIC NERVE EVALUATION TECHNIQUE

- DILATED PUPIL
- STEREOSCOPIC EVALUATION
- CLEAR 78/90/60/SUPERFIELD LENS AT SLIT-LAMP
- DETERMINE THE SIZE OF THE OPTIC NERVE
  - SMALL
  - MEDIUM
  - LARGE
- WHY?

HOW TO MEASURE OPTIC DISC DIAMETER

- USE 60D LENS AT SLIT LAMP OR CORRECTION FACTOR
  - SEE TABLE
- MAKE THIN VERTICAL BEAM, ADJUST BEAM HEIGHT
- READ HEIGHT OFF SCALE
  - > 2.2 mm IS A LARGE DISC
  - < 1.8 mm IS A SMALL DISC
  - THIS IS A ROUGH ESTIMATE
    - REFRACTIVE ERROR / WORKING DISTANCE INFLUENCE READINGS
- OTHER METHODS
  - DIRECT OPHTHAL (GROSS ESTIMATE)
  - CAMERAS WITH SOFTWARE
  - ADVANCED IMAGING DEVICES
    - HRT
      - DISC AREA SMALL / AVG / LARGE
    - OCT CIRRUS CALCULATES DISC AREA
      - 1.65-3.15 mm2 (avg 1.83)
      - SMALL <1.65
      - MEDIUM 1.65-1.97
      - LARGE >1.97

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<td>90 D</td>
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SIZE AWARENESS

• SMALL SIZED OPTIC NERVES
  • WITH SMALL CUPS = NO GLAUCOMA
  • WITH AVERAGE OR LARGE CUPS = SUSPICIOUS, LOOK FOR OTHER SIGNS

• MEDIUM SIZED OPTIC NERVES
  • WITH SMALL CUPS = NO GLAUCOMA
  • WITH AVERAGE CUPS = NO GLAUCOMA IF NO OTHER SIGNS
  • WITH LARGE CUPS = SUSPICIOUS, LOOK FOR OTHER SIGNS

• LARGE SIZED OPTIC NERVES
  • WITH SMALL CUPS = NO GLAUCOMA
  • WITH AVERAGE CUPS = NO GLAUCOMA IF NO OTHER SIGNS
  • WITH LARGE CUPS = NO GLAUCOMA OR SUSPICIOUS, LOOK FOR OTHER SIGNS

OPTIC DISC STRUCTURAL ABNORMALITIES

• DISC RIM CHANGES AT SUPERIOR OR INFERIOR POLES (ISNT RULE)
  • DIFFUSE THINNING OF RIM
  • FOCAL NARROWING OF RIM
  • NOTCHING OF RIM

• PROGRESSIVE NEURORETINAL RIM NARROWING / INCREASED CUPPING

• HEMORRHAGES AT DISC RIM, PARAPAPILLARY RNFL, LAMINA

• OPTIC DISC NEURAL RIM ASYMMETRY OF THE TWO EYES
  • CONSISTENT WITH LOSS OF NEURAL TISSUE

• LARGE EXTENT OF PARAPAPILLARY ATROPHY
DISC RIM CHANGES
AT SUPERIOR OR INFERIOR POLES

• DIFFUSE
  • CONCENTRIC
  OR
  • LOCALIZED TO ONE POLE
• FOCAL NARROWING OR NOTCHING

THE ISNT RULE

• 1988 FIRST REPORT BY JONAS ET. AL
  • 457 NORMAL EYES
    • INFERIOR RIM > SUPERIOR > NASAL > TEMPORAL
  • GLAUCOMA VIOLATES THE RULE
    • 80% OF THE TIME
      • WHAT ABOUT THE OTHER 20%?
• IT IS NOT FULLPROOF
  • VARIOUS STUDIES AGREE
    • DO NOT PLACE YOUR FULL FAITH IN ISNT RULE
PROGRESSIVE NEURORETINAL RIM NARROWING / INCREASED CUPPING

- OPTIONS TO CONSIDER
  - WAS PATIENT BORN THAT WAY
  - IS IT A RECENT CHANGE
  - IS IT A LONG TERM CHANGE

- HOW TO TELL?
  - LOOK FOR CHANGE OVER TIME
  - DRAWING, WRITTEN DESCRIPTIONS
    - NO LONGER GOOD ENOUGH
  - TAKE PICTURES
    - KEEP DOING THESE. SUPPLEMENTAL TO OCT
  - BILLING
    - DO PHOTOS ON DFE DAY
    - DO OCT SAME DAY AND NOT BILL
    - OR
    - DO OCT ON IOP CHECKS / VF DAY

HEMORRHAGES AT DISC RIM, PARAPAPILLARY RNFL, LAMINA

- HISTORY
  - 1889 BJERRUM
    - ASSOCIATION WITH GLAUCOMA
  - 1970 DRANCE AND BEGG
    - ASSOCIATION WITH OPEN-ANGLE GLAUCOMA

- APPEARANCE
  - FLAME OR SPLINTER SHAPED
    - RESULT OF ORIENTATION OF AXONS IN RNFL
    - MAY BE MISTAKEN FOR A BLOOD VESSEL
    - EXTEND RADIALY FROM THE OPTIC NERVE

- LOCATION
  - PRELAMINAR AREA OF THE OPTIC DISC
  - IN ADJACENT SUPERFICIAL RNFL
  - UPPER AND LOWER POLES
  - INFEROTEMPORALLY MOST COMMON

- DURATION
  - LAST FROM 2 WEEKS TO 8 MONTHS
  - 92% LAST MORE THAN 4 WEEKS
HEMORRHAGES AT DISC RIM, PARAPAPILLARY RNFL, LAMINA

• OHTS
  • POAG INCIDENCE OVER 8 YEARS
    • 13.6% WITH DISC HEME
    • 5.2% WITHOUT DISC HEME

• EMGT
  • 13% OF PATIENTS HAD DISC HEMES AT BASELINE
  • HEMORRHAGES ASSOCIATED WITH PROGRESSION

• ASSOCIATED WITH
  • NFL DEFECT, NOTCH, VF LOSS, LARGER C/D, PARAPAPILLARY ATROPHY
  • PREDICTS SITE OF RNFL DEFECTS

• NORMAL TENSION GLAUCOMA
  • RELATIONSHIP BETWEEN LOCATION AND PROGRESSION OF VF LOSS IN 65.4%

• SHOULD BE LOOKED FOR AT each VISIT
  • UNDILATED EVALUATION WITH DIRECT OR 90D LENS AT IOP CHECKS

HOW TO DETECT DISC HEMORRHAGES

• CLOSE OBSERVATION OF THE OPTIC NERVE
  • LOOK WHERE THERE’S A NOTCH
  • LOOK WHERE THE RIM IS THINNER
  • LOOK WHERE THERE IS A CLINICAL RNFL DEFECT
  • LOOK WHERE THERE IS AN OCT RNFL DEFECT
  • LOOK AT THE OPPOSITE LOCATION OF A VISUAL FIELD DEFECT

• THEY ARE NOT DETECTED BY THE OCT

• DISC PHOTOGRAPHS ARE THE MOST SENSITIVE METHOD
  • TAKE PHOTOS
  • REVIEW THEM
OPTIC DISC NEURAL RIM ASYMMETRY OF THE TWO EYES

• C/D ASYMMETRY
  • SUGGESTIVE OF GLAUCOMATOUS ONH DAMAGE
    • > 0.2 IN LESS THAN 0.5% OF NORMALS VS 48% IN GLAUCOMA
  • PREDICTOR OF FUTURE GLAUCOMATOUS VF LOSS
  • EVALUATE FOR SECONDARY FORMS OF GLAUCOMA
  • EYE WITH THE LARGER CUP TYPICALLY HAS THE HIGHER IOP
  • CAUTION
    • EVALUATE FOR UNEQUAL DISC SIZES

PARAPAPILLARY ATROPHY

• ZONE BETA
  • CLOSER TO ONH
  • COMPLETE LOSS OF RETINAL PIGMENT EPITHELIUM AND CHORIOCAPILLARIS
  • VISIBILITY OF LARGER CHOROIDAL BLOOD VESSELS AND WHITE SCLERA MORE SPECIFIC TO GLAUCOMA DAMAGE
  • INCREASE IN ZONE BETA
    • ASSOCIATION OF ADJACENT THINNING OF NEURO RETINAL RIM
    • ASSOCIATION OF DECREASED RNFL
  • ABSOLUTE SCOTOMA (ENLARGED BLIND SPOT) ON VISUAL FIELD
  • LESS SPECIFIC SIGN OF DAMAGE
PARAPAPILLARY ATROPHY

- Etiology is not clear
  - ? vascular
- Better sensitivity small discs vs C/D
- Associated with
  - Rim thinning
  - Conversion to glaucoma in patients with OC HTN
- Precursor to
  - VF loss (50-54%)
  - Disc damage (75%)
  - Disc hemorrhage
- Changes in 21% with progressive cupping vs 4% normals
- Look at photos for change

OTHER FEATURES THAT MAY INDICATE GLAUCOMATOUS OPTIC NEUROPATHY

- Nasalization of central ONH vessels
  - Nasalization on glaucoma
  - Nasalization on normal

- Baring of circumlinear vessel

- Absence of neuroretinal rim pallor. In other words... if pale, not glaucoma.
**SUMMARY…**

**5 RULES OF ONH EVALUATION**

- Observe the scleral Ring to identify the limits of the optic disc and its size
- Identify the size of the Rim
- Examine the Retinal nerve fiber layer
- Examine the Region of parapapillary atrophy
- Look for Retinal and Optic disc hemorrhages

**RETINAL NERVE FIBER LAYER STRUCTURAL ABNORMALITIES**

- ABNORMALITIES OF PARAPAPILLARY RNFL
  - DIFFUSE OR LOCALIZED
  - ESPECIALLY AT SUPERIOR / INFERIOR POLES
“A CHRONIC, PROGRESSIVE OPTIC NEUROPATHY IN ADULTS IN WHICH THERE IS A CHARACTERISTIC ACQUIRED ATROPHY OF THE OPTIC NERVE AND LOSS OF RETINAL GANGLION CELLS AND THEIR AXONS.”

**THE GLAUCOMA CONTINUUM**

Weinreb RN et al. AJO. September 2004

---

**HOW DO WE EVALUATE THE RNFL?**

**• CLINICALLY**

**• WITH A MACHINE**

Most will say they prefer the machine. Even experts agree. However, you should have a fundamental knowledge of what is being evaluated.
RNFL BACKGROUND

- OPTIC NERVE IS MADE OF
  - 700K-1.5 MILLION GANGLION CELLS
  - THE GANGLION CELL AXONS ARE THE RNFL
  - THEY THEN CROSS RETINA AND CONVERGE TO MAKE THE ONH
  - THEY EXIT THE EYE AT LAMINA ON WY TO LGN

- CLINICAL APPEARANCE
  - SUPERFICIAL BENEATH ILM
  - ARE IN AN ORGANIZED PATTERN
  - REFLECT LIGHT BACK
  - THE THICKER THE RNFL THE BRIGHTER THE STRIATIONS
    - SUPERIOR / INFERIOR POLES
  - BEST SEEN AGAINST A DARK BACKGROUND
    - DIFFICULT IN A BLONDE FUNDUS
  - NEED CLEAR MEDIA

NORMAL RNFL FEATURES

- FINE WHITE LINEAR STRIATIONS IN ANTERIOR RETINAL LAYER
- BRIGHT STRIATIONS WITH A FULMINANT, COARSE TEXTURE
- CAST A WHITE HAZE OVER THE UNDERLYING RETINAL LAYERS
- TERTIARY BLOOD VESSELS ARE HIDDEN BENEATH THE RNFL
- BECOMES BRIGHTER AS YOU GET CLOSER TO THE ONH
- MOST PROMINENT IN THE SUPERIOR AND INFERIOR ARCADES
- BRIGHT-DIM-BRIGHT PATTERN
RETINAL NERVE FIBER LAYER DEFECTS

• FIRST DESCRIBED
  • 1973 HOYT ET. AL
    • LOCALIZED RNFL DEFECTS IN GLAUCOMATOUS EYES
  • 1991 SOMMER, KATZ, QUIGLEY, MILLER ET AL
    • CLINICAL RNFL DEFECTS MAY PRECEDE VF LOSS BY 6 YEARS
  • NORMAL EYES DO NOT HAVE RNFL DEFECTS
  • WHEN PRESENT, ALMOST ALWAYS SIGNIFY PATHOLOGY
    • NOT ALWAYS GLAUCOMA
  • OTHER POTENTIAL CAUSES OF RNFL DEFECTS
    • ANY OPTIC NEUROPATHY
    • ANY RETINOPATHY
    • OTHER RETINAL PATHOLOGY
    • SYSTEMIC DISEASES
      • MS, OTHERS

FOCAL RNFL DEFECTS

• SLIT DEFECT
  • EVIDENCE OF FOCAL DAMAGE
  • LARGER THAN ARTERIOLE WIDTH
  • TRAVELS ALL THE WAY TO ONH
  • ¼ mm WIDE = 50 um LOSS
  • 50 um LOSS = 15,000 FIBERS
  • 15,000 FIBERS = 1% OF TOTAL
  • WEDGE DEFECT
    • EASIEST TO IDENTIFY, LEAST COMMON
    • AN EXPANDING LOSS OF GANGLION CELLS
    • ASSOCIATED ONH NOTCHING
    • ASSOCIATED WITH A VF DEFECT
    • MAY OCCUR AFTER DISC HEME
**DIFFUSE RNFL LOSS**

- Most common
- Hardest to identify
- Loss of striations in the superior and inferior arcuate bundles
- Raked or thinned appearance
- Striations are less bright
- Texture is finer
- Tertiary vessels are visible
- Compare superior to inferior
- Look for rim thinning or notch
- Compare right to left eye
- Reversal may occur late in disease
  - Dim / Bright / Dim

**THAT’S HARD**

- Take pictures
- Go back and look at them
- Compare to
  - ONH appearance
  - Visual field
  - And if available...do an optic nerve RNFL scan
    - OCT, GDX, HRT
- Look for change over time
“HIGHLIGHTS” IN THE HISTORY OF RNFL / OCT EVALUATION

1991
Clinical RNFL Loss MAY precede VF loss by 6 years

1995
First Glaucoma OCT Developed

2006
Time Domain OCT Predicts Early Glaucoma

2015
OCT may detect glaucoma 8 years prior to VF loss

1991
First OCT Developed

2000
RNFL Photos vs Time Domain OCT are Similar

2009
Spectral Domain OCT Similar to Time Domain

2011
Spectral Domain OCTs are all Similar

Clinically Detectable Nerve Fiber Atrophy Precedes the Onset of Glaucomatous Field Loss

Computer Based ONH / RNFL Analysis

• OPTIONS
  • GDX (RNFL), HRT (ONH, RNFL, Macula, Cornea), OCT (RNFL, Macula), Etc.
    • ALL REVISED SINCE INCEPTION
    • STUDIES HAVE SHOWN VARIOUS STRENGTHS / WEAKNESSES
    • DIAGNOSTIC CAPABILITIES
      • USED TO HELP DISCRIMINATE NORMALS FROM EARLY GLAUCOMA
      • USED TO MONITOR FOR CHANGE (PROGRESSION)
WHAT DOES THE AAO SAY ABOUT ONH DOCUMENTATION / ANALYSIS?

• APPEARANCE OF ONH SHOULD BE DOCUMENTED
  • COLOR STEREOPHOTOGRAPHS ARE ACCEPTABLE
  • COMPUTER ANALYSIS OF ONH AND RNFL IS AN ALTERNATIVE

• 3 TYPES OF COMPUTER BASED IMAGING
  • SIMILAR IN ABILITY TO DISTINGUISH GLAUCOMA FROM CONTROLS
  • USEFUL, WHEN ANALYZED IN CONJUNCTION WITH OTHER RELEVANT CLINICAL PARAMETERS

• EACH METHOD IS COMPLEMENTARY

TRENDS IN DIAGNOSTIC TESTING

• 2001-2009 STUDY
  • MANAGED CARE NETWORK
  • PATIENTS OF OD OR MD
  • > 40 YO, AT LEAST 1 VISIT

• DIAGNOSES
  – OAG = 169,917
  – OAG SUSPECTS = 395,721

• RATES OF CHANGE
  – IMAGING
    • OPHTHALMOLOGISTS INCREASED BUT NOT AS MUCH AS OPTOMETRISTS
  – VISUAL FIELDS
    • OPHTHALMOLOGISTS DECREASED BUT NOT AS MUCH AS OPTOMETRISTS

Ophthalmology 2012; 119: 748-758
WHICH OCT TO USE?
THAT’S YOUR CALL

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<td>Heidelberg Engineering, Inc.</td>
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<td>NIDEK</td>
<td>Retina Scan Duo™ Optical Coherence Tomography</td>
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<td>iVue Spectral-Domain OCT</td>
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<tr>
<td>ZEISS</td>
<td>CIRRUS™ HD-OCT 500- The Essential OCT</td>
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THE NORMATIVE DATABASE

• CIRRUS
  • 284 “NORMAL” PATIENTS
  • QUALITY SCORE > 6
  • AGE 19-84 (MEAN 46.5)
  • REFRACTIVE ERROR -12 TO +8
  • ETHNIC “DIVERSITY”
    • 43% CAUCASIAN (122)
    • 24% ASIAN
    • 18% AFRICAN AMERICAN (51)
    • 12% HISPANIC (34)
    • 1% INDIAN
    • 6% MIXED ETHNICITY

• SPECTRALIS
  • 201 “NORMAL” PATIENTS
  • 111 MALES, 90 FEMALES
  • AGE 18-78 (MEAN 48)
  • REFRACTIVE ERROR -7 TO +5
  • 100% CAUCASIAN
FACTORS THAT IMPACT THE CIRRUS NORMATIVE DATABASE

• RNFL
  • SOFTWARE DOES COMPARE AGE TO AGE FOR RNFL EVALUATION
  • SOFTWARE DOES NOT COMPARE BASED ON ETHNIC GROUP
    • FYI: SPECTRALIS IS ONLY CAUCASIANS (A BIG DEAL OR NOT?)

• DISC SIZE
  • DISC AREA 1.06 -3.38 mm² (avg 1.83)
    • SMALL < 1.63
    • MEDIUM 1.63-1.97
    • LARGE > 1.97
  • SOFTWARE DOES COMPARE DISC SIZE FOR ONH EVALUATION
  • SMALL OR LARGE DISC AREA NOT COMPARED DUE TO TOO FEW IN DATABASE
  • SOFTWARE DOES NOT COMPARE DISC SIZE FOR RNFL EVALUATION

CIRRUS ONH / RNFL ANALYSIS

• COLORS ARE NOT
  • NORMAL
  • THIN
  • LOSS
• COLORS ARE PATIENT COMPARED TO NORMALS
  • WHITE - UPPER 5% OF NORMALS
  • GREEN – MIDDLE 90% OF NORMALS
  • YELLOW – LOWER 5% OF NORMALS
  • RED – LOWEST 1% OF NORMALS
  • GRAY – NOT COMPARED
CIRRUS ONH ANALYSIS

• RIM AREA (RELEVANT? MAYBE)
  • RANGE 0.75-2.38 mm² (AVG 1.31)
  • COMPARED TO NORMALS?
    • PEOPLE HAVE A NUMBER GANGLION CELLS (700K-1.5 MILLION)
    • CANNOT ACCOUNT FOR THIS OTHER THAN TO AVG VALUES

• RANGE 0.75-2.38 mm² (AVG 1.31)

• COMPARED TO NORMALS?
  • PEOPLE HAVE A NUMBER GANGLION CELLS (700K-1.5 MILLION)
  • CANNOT ACCOUNT FOR THIS OTHER THAN TO AVG VALUES

• DISC AREA (RELEVANT)
  • ALWAYS GRAY
  • LARGER DA HAVE LARGER C/D, MORE NEURO RIM TISSUE
    • 1.06-3.38 mm² (AVG 1.83)
    • SMALL <1.63 / MEDIUM 1.63-1.9 / LARGE > 1.97

• C/D RATIO (RELEVANT)
  • DEPENDENT ON DISC AREA
  • NUMBER OF GANGLION CELL AXONS IN RETINA
  • INCREASES AS GANGLION CELL AXONS ARE LOST
  • VERTICAL C/D MORE IMPORTANT

• CUP VOLUME (NOT RELEVANT)
  • INCREASES AS EXCAVATION INCREASES
  • POORER REPRODUCIBILITY

GUIDE FOR SUSPECTING GLAUCOMA USING THE CIRRUS FOR ONH ANALYSIS

• ABNORMAL ONH RIM AREA
  • <=5% OR <=1%

• ABNORMAL VERTICAL C/D
  • <=5% OR <=1%

• NO DIFFERENCE IN ABILITY OF ONH PARAMETERS COMPARED TO RNFL PARAMETERS TO DISTINGUISH BETWEEN NORMAL AND GLAUCOMATOUS EYES
  • = JUST AS GOOD AS THE RNFL ANALYSIS
  • THEREFORE...DON’T SKIP IT. LOOK AT IT.
CIRRUS RNFL ANALYSIS

Information can be loosely applied to Spectralis

- **AVG (GLOBAL) RNFL THICKNESS**
  - Compared to normative database
  - Thickness of ganglion cell axons 360 degrees around ONH
  - It includes RNFL, blood vessels, astrocytes, glial cells
  - Is a global index. It will miss focal damage.
  - Look for R/L asymmetry.

- **QUADRANTS**
  - Compared to normative database
  - Look where mild glaucoma occurs
    - Superior
    - Inferior
  - Signs of focal damage
  - Look for R/L asymmetry

- **CLOCK HOURS (SECTORS)**
  - Compared to normative database
  - Look where mild glaucoma occurs
    - Super, superior temporal
    - Inferior, inferior temporal
  - Signs of focal damage
  - Look for R/L asymmetry

- **RNFL THICKNESS MAP**
  - Similar to appearance of the GDX
  - Not as detailed
  - “More blurry”
  - Is a topographical display of the RNFL
  - An “hourglass” pattern
    - Thicker superior and inferior
    - Red/yellow = thicker
    - Blue as RNFL thins / decreases

- **RNFL DEVIATION MAP**
  - Boundaries of the cup and disc are plotted
    - Too small to be of use?
  - RNFL deviations from normal are plotted
    - Yellow < 5% of normals
    - Red < 1% of normals
CIRRUS ONH / RNFL SYMMETRY ANALYSIS

- NEURO-RETINAL RIM THICKNESS SYMMETRY
  - COMPARED TO NORMATIVE DATABASE
    - LOOK FOR R / L ASYMMETRY

- RNFL THICKNESS / CONTOUR SYMMETRY
  - COMPARED TO NORMATIVE DATABASE
    - LOOK FOR R / L ASYMMETRY
    - DIFFERENCES BETWEEN EYES
    - FOCAL DIPS AT SUP / INF POLES

MY GUIDE FOR SUSPECTING GLAUCOMA
(IF YOU THINK THE CLINICAL ONH / RNFL LOOKS SUSPICIOUS)
USING THE CIRRUS FOR THE RNFL
(COMPILED FROM VARIOUS ARTICLES)

Average thickness outside 95% CI (yellow <5% or red <1%)

OR

1 quadrant (sup / inf) outside 95% CI (yellow <5% or red <1%)

OR

2 clock hours (not directly temporal, nothing nasally) outside 95% CI (yellow <5% or red <1%)

OR

Asymmetry between the R / L eyes’ average thickness / quad / clock hr / sector > 9 um

Information can be loosely applied to Spectralis
2 clock hours = 1 Spectralis sector
**DOES THE ONH / RNFL GUIDE I PROVIDED ALWAYS WORK?**

- **NOT ALWAYS**
  - Use the information compiled from the literature as a general guide
  - No one method will diagnose every patient
  - Your device may be slightly different
  - Do not compare data across devices

- **RESULTS SHOULD CORRELATE WITH YOUR CLINICAL EXAM**
  - ONH
  - RNFL
  - VISUAL FIELD

**KEEP IN MIND**

- **RED DISEASE (FALSE POSITIVE)**
  - A **RED** OCT that is believed to be glaucoma but may be indicative of another disease or just **red** as a result of poor imaging quality
    - Ex: Decentration, PVD, Segmentation error, poor signal quality, etc.

- **GREEN DISEASE (FALSE NEGATIVE)**
  - A **green** OCT that is believed to be normal but actually has clinically detectable evidence of glaucoma found by methods of testing other than just looking at the colors on the OCT
    - Ex: Visible notch / disc hemorrhage / clinical focal RNFL defect but OCT is **green**
SHOULD YOU STILL BOTHER TO LOOK AT THE ONH OR RNFL?

• YES
  • YOU ARE THE DOCTOR
  • DO NOT RELY ON A MACHINE
  • LOOKING ALLOWS YOU TO DETERMINE IF
    • NORMAL, SUSPICIOUS, DAMAGE
  • CORRELATE WHAT SEEN CLINICALLY WITH WHAT SHOWN ON THE OCT
  • THINGS YOU MAY SEE DON’T ALWAYS SHOW UP ON OCT
    • NOTCH, DISC HEME, CHANGE

BE AWARE, IF THERE IS ONH DAMAGE OR RNFL LOSS BEFORE VISUAL FIELD LOSS…

• PREVIOUSLY KNOWN AS PREPERIMETRIC GLAUCOMA
  • THE CONCEPT REFERS TO GLAUCOMATOUS DAMAGE, USUALLY MANIFESTED BY A SUSPICIOUS OPTIC DISC AND / OR THE PRESENCE OF RETINAL NERVE FIBER LAYER DEFECTS, IN WHICH NO VISUAL FIELD ABNORMALITY HAS DEVELOPED.

• NOW = MILD / EARLY GLAUCOMA
  • CONSIDER TREATMENT
**QUESTION**

GLAUCOMA IS A DISEASE OF…?

1. THE INTRAOCULAR PRESSURE  
2. THE VISUAL FIELD  
3. THE OPTIC NERVE  
4. THE RETINAL NERVE FIBER LAYER  
5. THE RETINAL GANGLION CELLS

“A CHRONIC, PROGRESSIVE OPTIC NEUROPATHY IN ADULTS IN WHICH THERE IS A CHARACTERISTIC ACQUIRED ATROPHY OF THE OPTIC NERVE AND LOSS OF RETINAL GANGLION CELLS AND THEIR AXONS.
STRUCTURAL LOSS

- **3 AREAS IMPACTED**
  - OPTIC NERVE
    - VISUALIZED
    - MEASURABLE
  - NERVE FIBER LAYER
    - VISUALIZED
    - MEASURABLE
  - GANGLION CELLS
    - NOT VISUALIZED
    - MEASURABLE

RETINAL GANGLION CELLS

- **700K-1.5 MILLION RETINAL GANGLION CELLS**
- **50% LOCATED WITHIN 4.5 mm OF THE FOVEA**
- **LESS VARIABILITY AMONG NORMAL INDIVIDUALS THAN ONH AND RNFL**
WHY IMAGE THE GANGLION CELLS

• SINCE A LARGE PROPORTION OF RGCS RESIDE IN THE MACULA, LOSS MIGHT BE A SIGN OF GLAUCOMATOUS DAMAGE

• MACULAR VOLUME
  • NORMALS > SUSPECTS > EARLY GLAUCOMA > ADVANCED

• CORRELATION BETWEEN MACULAR THICKNESS AND VF MD
  • GREENFIELD DS ET AL. Arch Ophthal. 2003;121(1):41-46

• MACULAR THICKNESS CORRELATES WITH PERIPAPILLARY RNFL

RETNAL GANGLION CELLS

• GLAUCOMA AFFECTS THE GANGLION CELL COMPLEX (GCC)
  • RNFL
    • AXONS OF GANGLION CELLS
  • GANGLION CELL LAYER
    • CELL BODIES
  • INNER PLEXIFORM LAYER
    • DENDRITES
GCC vs THE RNFL

- 2014 JAPANESE STUDY
  - TOPCON 3D OCT 2000
  - 264 EYES
    - 84 HEALTHY EYES, 68 PREPERIMETRY, 72 EARLY GLAUCOMA
  - RETINAL GANGLION CELL COMPLEX MEASUREMENT IS AS ACCURATE AS CIRCUMPAPILLARY RNFL MEASUREMENT
  - GCC EVAL MAY BE USEFUL IN
    - LARGE OR SMALL DISC
    - PERIPAPILLARY ATROPHY
    - TILTED DISC

GUIDE FOR SUSPECTING GLAUCOMA USING THE CIRRUS FOR GCC

AREAS OF INTEREST
- MINIMUM
  - BEST PERFORMANCE (2013 study)
- INFEROTEMPORAL
  - BEST PERFORMANCE (2012 study)

RESULTS NOT APPLICABLE TO PATIENTS WITH CONCURRENT MACULAR DISEASE
- AMD, CSME, CME, ERM, ETC.
- NO ONE TEST IS SUFFICIENT FOR ALL PATIENTS
  - NEED ONH, RNFL, GCC, VF
THE GCA
“SQUEEGEE SIGN”

- GLAUCOMA
  - INITIALLY DAMAGES TEMPORAL SIDE OF GANGLION CELL BODIES IN MACULA
  - ASYMMETRICALLY DAMAGES BETWEEN SUPERIOR / INFERIOR GANGLION CELL BODIES

- “SQUEEGEE SIGN” TO THE SUPERIOR OR INFERIOR TEMPORAL GANGLION CELL BODIES IS THE INITIAL INDICATION OF GLAUCOMA DAMAGE ON THE GCA

THE GCA IS REPRODUCIBLE

MILD GLAUCOMA

MODERATE GLAUCOMA

SEVERE GLAUCOMA

5 VISITS OVER 2 MONTHS
SPECTRALIS FOR GCC

- 61 LINES, CENTRAL 20 DEGREES
- 6x6 mm SCAN
  - EQUIVALENT TO 10 DEGREE VF
- 8X8 GRID REPORT
- NO NORMATIVE DATABASE
  - ONE IS COMING
- COMPARISON
  - PATIENT SUPERIOR TO INFERIOR
  - PATIENT RIGHT TO LEFT
- ANOTHER STUDY
  - HIGH DIAGNOSTIC SENSITIVITY (83.3%) AND SPECIFICITY (92.6%) WHEN USING 3 CONSECUTIVE BLACK CELLS TO DETECT GLAUCOMA

Asrani S, Rosdahl, JA, Allingham RR. Arch Ophthal, Vol 129 (9), Sept 2011: 1205-11

CAN MY OCT DO THAT?

- FROM PREVIOUS ARTICLE
  - ALSO THE TOPCON 3D OCT 2000
- OTHERS?
- DIFFERENCES EXIST BASED ON WHAT IS ACTUALLY BEING SCANNED
  - ENTIRE MACULA THICKNESS
  - GCC
    - RNFL / GC / IPL
    - GC / IPL
- WHICH IS BEST?
  - THAT DEPENDS ON THE STUDY
DISCLAIMER

- OTHER THINGS CAN CAUSE GANGLION CELL LOSS
  - ANY OPTIC NEUROPATHY
  - ANY RETINOPATHY
  - OTHER RETINAL PATHOLOGY
  - OTHER NEUROLOGIC DISEASES
    - ALZHEIMERS
    - PARKINSONS
    - MS
    - ETC.

RELIABLE AND REPRODUCIBLE VISUAL FIELD ABNORMALITY

- CONSISTENT WITH RETINAL NERVE FIBER LAYER DAMAGE
  - NASAL STEP
  - ARCUATE DEFECT
  - PARACENTRAL DEPRESSION IN CLUSTERS OF TEST SITES

- VISUAL FIELD LOSS ACROSS HORIZONTAL MIDLINE IN ONE HEMIFIELD EXCEEDS LOSS IN THE OPPOSITE HEMIFIELD (IN EARLY / MODERATE CASES)

- ABSENCE OF OTHER EXPLANATIONS
WHY DO WE STILL DO VISUAL FIELDS?

- 2002 OHTS
  - 35% patients had VF loss without signs of structural progression
- 2009 STUDY
  - 34% of glaucoma suspect converters progressed on visual field without structural changes

A NORMAL VISUAL FIELD DOES NOT EXCLUDE GLAUCOMA

- NORMAL FIELD EXCLUDES MODERATE / SEVERE DISEASE
  - BUT DOES NOT RULE IT OUT
  - DUE TO OVERLAP OF RECEPTOR SITES IN THE RETINA
- 20-40% OF RGC LOST BEFORE 5-10 DB VF REDUCTION
- SOME SHOW INNOCUOUS VF DESPITE GLAUCOMA
- VF WILL EVENTUALLY CATCH UP TO THE ONH
- IF NORMAL BUT STILL STRONGLY SUSPICIOUS ONH
  - CONSIDER ADDITIONAL ONH / RNFL / GCC / ALTERNATIVE VF TESTING
    - FDT
    - 10-2
WHICH VF DEVICE TO USE?
THAT’S YOUR CALL

OCULUS
CENTER FIELD / EASYFIELD

HAAG-STREIT OCTOPUS

HUMPHREY
FDT / MATRIX / HFA II/III

VF LOSS = MODERATE OR SEVERE DAMAGE
EARLY IN DISEASE
• BASELINE VF
• FOLLOW OPTIC NERVE / RNFL FOR CHANGES

LATE IN DISEASE
• FOLLOW VISUAL FIELD FOR CHANGES
• MAY HAVE TO CONSIDER 10-2 OR MACULA VF
• SIZE V TARGET 24-2 OR 10-20
• ESTERMAN FOR DRIVING OR KINETIC III4e FOR LEGAL BLINDNESS

IS IT GLAUCOMATOUS?
• OBVIOUS DEFECTS
  • THE NASAL STEP
  • THE ARCUATE DEFECT
  • THE PARACENTRAL DEFECT
• DIFFUSE VISUAL FIELD LOSS ?
  • TYPICALLY NOT GLAUCOMA

EARLIEST DEFECTS?
• FIELD MUST MATCH THE OPTIC NERVE / RNFL
MINIMUM DIAGNOSTIC CRITERIA FOR A GLAUCOMATOUS VISUAL FIELD

- IN THE ABSENCE OF OTHER CAUSES FOR FIELD ABNORMALITY AND IN THE PRESENCE OF SUSPICION FOR GLAUCOMA
  - TWO “OUTSIDE NORMAL LIMITS” ON GHT
    - CLINICAL DECISION IN GLAUCOMA, 2ND EDITION
  - CLUSTER OF THREE OR MORE POINTS IN A LOCATION TYPICAL FOR GLAUCOMA, ALL DEPRESSED ON PATTERN DEVIATION PLOT AT A P < 5% AND ONE DEPRESSED AT A P < 1% ON TWO CONSECUTIVE FIELDS (24-2 COUNTS EDGE POINTS, 30-2 ONLY COUNTS 2 NASAL PTS). ALL PTS RESPECT HORIZONTAL MERIDIAN
  - PSD P < 5% (SUMMARIZES EXTENT OF LOCALIZED LOSS, NOT AFFECTED BY GENERALIZED DEPRESSION)
    - CLINICAL DECISION IN GLAUCOMA, 2ND EDITION
- IF REPEATABLE
  - Budenz, D. African Glaucoma Summit 8/06/10

WHAT MEETS THE MINIMUM CRITERIA?

THE VF DEFECT STILL MUST CORRELATE WITH THE OPTIC NERVE APPEARANCE AND RNFL APPEARANCE / OCT
CLASSIFY THE STAGE OF GLAUCOMA BASED ON VISUAL FIELD LOSS...

**Moderate Stage Glaucoma**
ICD-9 365.72; ICD-10 7th digit “2”
- Optic nerve abnormalities consistent with glaucoma
- AND glaucomatous visual field abnormalities in ONE hemifield and
- NOT within 5 degrees of fixation (note: 5 degrees = involvement of spots nearest fixation)

**Advanced, Late, Severe Stage**
ICD-9 365.73; ICD-10 7th digit “3”
- Optic nerve abnormalities consistent with glaucoma
- AND glaucomatous visual field abnormalities in BOTH hemifields
- AND/OR loss within 5 degrees of fixation in at least one hemifield.

STD / FAST (OR FASTER)?

- MAJORITY OF CLINICAL TRIALS / STUDIES DONE WITH SITA STANDARD
- EXPERTS OPINION
  - STD IS MORE PRECISE
  - UNLIKELY TO MAKE SIZEABLE DIFFERENCE TO IMPROVE THE TIME TO DETECT VF PROGRESSION
- THOUGHTS
  - PATIENTS PREFER A FASTER PROGRAM
  - MAY HELP RELIABILITY
  - START PATIENTS WITH SITA FAST
  - CONVERT STD TO FAST
    - IT DEPENDS. IF EARLY IN PROCESS
    - GPA DATA NOT COMPARABLE
- NEWEST PROGRAM
  - FASTER
  - AVAILABLE ON HFA 3

Measurement Precision in a Series of Visual Fields Acquired by the Standard and Fast Versions of the Swedish Interactive Thresholding Algorithm Analysis of Large-Scale Data From Clinics

10-2 or 24-2?

CONCLUSION (FOR NOW): MORE STUDY IS NEEDED

SHOULD YOU ORDER A 10-2 FOR SUSPECTS?
MY OPINION

- START WITH 24-2
  - STANDARD PREFERRED OVER FAST BUT STICK WITH WHAT YOU STARTED (FUTURE SITA FASTER?)
    - TIME SAVINGS NOT MUCH
    - EXTENT/DEPTH OF DEFECT MAY BE UNDERESTIMATED ON FAST
- IF ABNORMAL, STICK WITH IT
  - SHOULD MATCH
    - ONH
    - CLINICAL RNFL
    - OCT
- IF 24-2 HAS CENTRAL INVOLVEMENT
  - DO 10-2
- IF 24-2 NORMAL AND ONH / RNFL / OCT / GCC ARE ABNORMAL OR SUSPICIOUS
  - CONSIDER FDT AND/OR 10-2
- REGARDLESS…MONITOR FOR CHANGE
HFA3

New SITA Faster 24-2C Test

- More information in the central 10 degrees where macular visual field defects reside.
- The 24-2C test pattern combines all 24-2 points plus ten selected points from the 10-2 pattern that cover areas known to be susceptible to glaucomatous defects both from structural and functional studies (1-6)
- SITA™ Faster 24-2C test takes ~20% less time than SITA Fast 24-2 test

SOME OTHER TESTS
OCULAR RESPONSE ANALYZER

- AROUND SINCE 2008
- MEASURES
  - BIOMECHANICAL PROPERTIES OF CORNEA
  - SPECIFICALLY: CORNEAL HYSTERESIS
    - THEORY
      - THOUGHT TO REPRESENT VISCOELASTICITY
      - CORNEAL DAMPENING CAPACITY
        - RESISTANCE TO DEFORMATION
        - ABILITY TO BUFFER FLUCTUATIONS IN IOP
        - ABILITY TO ABSORB / DISSIPATE ENERGY
  - COMPANIES: REICHERT

CORNEAL HYSTERESIS

- GLAUCOMA INTERPRETATION
  - HIGHER CORNEAL HYSTERESIS (> 9)
    - MORE LIKELY TO CUSHION SHORT / LONGTERM IOP INCREASES = MORE PROTECTIVE

  - LOWER CORNEAL HYSTERESIS (< 9)
    - LOWER CAPACITY TO DAMPEN IOP SPIKES AND/OR REDUCED ABILITY OF ONH STRUCTURES TO RESPOND TO IOP FLUCTUATIONS
    - INCREASED RISK FOR DEVELOPING GLAUCOMA
    - 2006, 2012 STUDIES
      - ASSOCIATED WITH PROGRESSIVE VF WORSENING

- CAN IT HELP IMPACT TREATMENT DECISIONS?
  - LESS CONCERNED IN A PATIENT WITH HIGH IOP AND HIGH CORNEAL HYSTERESIS
    - LESS LIKELY TO PROGRESS
  - MORE CONCERNED IN A PATIENT WITH LOW CORNEAL HYSTERESIS
    - MORE LIKELY TO HAVE RAPID PROGRESSION
    - BE MORE AGGRESSIVE IN TREATMENT, FOLLOW MORE FREQUENTLY
ELECTRORETINOGRAPHY

- **PATTERN ERG**
  - Measures activity of retinal ganglion cells
- **THEORY**
  - Tests healthy/unhealthy cells
  - Not dead cells
  - OCT ganglion cell loss
  - Visual field defect
  - Detect functional abnormality early in disease
  - Once damage, use VEP
- **COMPANIES**
  - LKC Technologies, Konan Medical, Metrovision, Diopsys

OCT ANGIOGRAPHY and GLAUCOMA

- **USES**
  - Retina
    - DM Ret, dry/wet AMD, CSC, vascular occlusion, mac telangiectasia, CNVM
  - Glaucoma
    - Optic disc perfusion
    - Macular perfusion
  - Uveitis
    - Superficial / deep retinal capillary plexus
    - Choriocapillaris
- **THEORY**
  - Glaucoma patients have
    - Reduced blood supply in optic nerve and peripapillary region
- **COMPANIES**
  - Optovue, Zeiss
THERE ARE GLAUCOMA RISK CALCULATORS (BUT ONLY FOR PATIENTS WITH OCULAR HTN)

https://ohts.wustl.edu/risk/

RISK ASSESSMENT: SIMPLIFIED

Glaucoma Quick Reference Guide

Risk Factors for OAG Suspect Codes
- African American or Hispanic race
- Family history of glaucoma in 1st degree relative
- This central corneal thickness
- High IOP
- Pseudoexfoliation or pigment dispersion syndrome


AMERICAN ACADEMY OF OPHTHALMOLOGY. Preferred Practice Pattern 2015
LOW OR HIGH RISK...
CAN IT BE THAT SIMPLE?

KH

57 / W / M
• CC: no changes in vision, no ocular comfort problems, glasses in good repair
• Oc Hx:
  • LEE 6 mos, .4/.3, iop 32/30, iop range 22-32/19-30, pachym: 644/629
• Oc Meds:
  • none
• Med Hx:
  • +DM, +Chol
• Fam Hx:
  • none

• BVA:
  • +175-275x097 20/20-1
  • +125-225x082 20/20
• FTFC OD OS, FROM, No APD
• SLE: Unremarkable OU
• IOP: 27/25 mmHg @ 950a
• DFE: see photos
WHAT’S YOUR DIAGNOSIS?

• NORMAL OR PHYSIOLOGIC CUPPING
• OCULAR HYPERTENSION
• GLAUCOMA SUSPECT
  • LOW RISK (< 2 RISK FACTORS)
  • HIGH RISK (3 OR MORE RISK FACTORS)
• GLAUCOMA UNDETERMINED STAGE
• MILD OPEN ANGLE GLAUCOMA
• MODERATE OPEN ANGLE GLAUCOMA
• SEVERE OPEN ANGLE GLAUCOMA

CIRRUS
RNFL / GCC
ONH / RNFL / VISUAL FIELDS
IF NORMAL...ASSESS FOR RISK

ONH / RNFL / VISUAL FIELDS

VISUAL FIELDS
• GHT ONL
• CLUSTER OF THREE POINTS IN AREA TYPICAL FOR GLAUCOMA, ALL <5% , ONE <1%
• PSD <5%
• REPEATABLE
• MATCHES ONH/RNFL

Risk Factors for OAG Suspect Codes
• African American or Hispanic race
• Family history of glaucoma in 1st degree relative
• Thin central corneal thickness
• High IOP
• Pseudoxfolliation or pigment dispersion syndrome
≥ 5 risk factors = high risk
≥ 2 risk factors = low risk

ONH in Early Stage Glaucoma
• OCT RNFL: AVG/Global <5 OR <1
• SUP/INF QUADS <5 OR <1
• ST/IT CLK/SECTORS <5 OR <1
• ASYMMETRY > 9 um

ONH in Moderate Stage Glaucoma
• OCT RNFL: AVG/Global <5 OR <1
• SUP/INF QUADS <5 OR <1
• ST/IT CLK/SECTORS <5 OR <1
• ASYMMETRY > 9 um

ONH in Advanced, Late, Severe Stage Glaucoma
• OCT RNFL: AVG/Global <5 OR <1
• SUP/INF QUADS <5 OR <1
• ST/IT CLK/SECTORS <5 OR <1
• ASYMMETRY > 9 um

RISK ASSESSMENT

• 57 / W / M
• NO FAM HISTORY
• PACHYM: 644/629
• IOP 22-32/19-30
• NO PXE / PDS
• DX:
  • LOW RISK OAG SUSPECT
  • OR
  • OCULAR HYPERTENSION
JL

• 44 / AA / M
• CC: glaucoma suspect evaluation, no vision/comfort problems
• OC HX:
  • LEE 1 MOS, glaucoma suspect: .8/.85, iop 21/21
• OC MEDS:
  • none
• MED HX:
  • unremarkable
• ALLERGIES:
  • none
• FAM HX:
  • -DM, -glaucoma, -blind
• SOC HX:
  • -etoh, -tobacco

• BVA:
  • 20/20 OD PL DS
  • 20/20 OS PL-05X090
• FROM, Normal Pupils, NO APD
• CF: FTFC OD, FTFC OS
• SLE: OU dermatochalasis
• IOP: 23/23 mm Hg @ 1022a
• PACHYM: 474/475
• GONIO: open to CBB 360, no PAS/recess/NV, trace pigment
• DFE: see photos

ONH PHOTOS

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WHAT’S YOUR DIAGNOSIS?

- NORMAL OR PHYSIOLOGIC CUPPING
- OCULAR HYPERTENSION
- GLAUCOMA SUSPECT
  - LOW RISK (< 2 RISK FACTORS)
  - HIGH RISK (3 OR MORE RISK FACTORS)
- GLAUCOMA UNDETERMINED STAGE
- MILD OPEN ANGLE GLAUCOMA
- MODERATE OPEN ANGLE GLAUCOMA
- SEVERE OPEN ANGLE GLAUCOMA

RNFL
ONH / RNFL / VISUAL FIELDS
IF NORMAL...ASSESS FOR RISK

- GHT ONL
- CLUSTER OF THREE POINTS IN AREA TYPICAL FOR GLAUCOMA, ALL <5%, ONE <1%
- PSD <5%
- REPEATABLE
- MATCHES ONH/RNFL

OCT RNFL EVAL
- AVG / GLOBAL
  - <5 OR <1
- SUP / INF QUADS
  - <5 OR <1
- ST / IT CLK / SECTORS
  - <5 OR <1
- ASYMMETRY > 9 um

Risk Factors for OAG Suspect
Codes
- African American or Hispanic race
- Family history of glaucoma in 1st degree relative
- Thin central corneal thickness
- High IOP
- Pseudoxfoliation or pigment dispersion syndrome

≥ 3 factors = high risk
≥ 2 factors = low risk

RISK ASSESSMENT

- 44 / AA / M
- NO FAMILY HISTORY
- PACHYM: 474/475
- IOP 21-23/21-23
- NO PXE / PDS
- DX: HIGH RISK GLAUCOMA SUSPECT
FINALLY

• CONSIDER EVERYONE A SUSPECT
• GATHER INFORMATION FOR OR AGAINST DX
• RECOGNIZE SIGNS OF GLAUCOMA
• ASSESS THE RISK
• TREAT THOSE GREATEST RISK OR WITH OAG
• MONITOR FOR CHANGE
• ADJUST TREATMENT
• REASSESS PERIODICALLY

Risk Factors for OAG Suspect Codes

• African American or Hispanic race
• Family history of glaucoma in 1st degree relative
• Thin central corneal thickness
• High IOP
• Pseudoexfoliation or pigment dispersion syndrome

≥ 3 risk factors = high risk
≤ 2 risk factors = low risk