Multifactorial Optic Neuropathies

- ICD-9 lists 34 different types of glaucoma
- Progressive retinal ganglion cell loss
- Gradual optic disc cupping
- Associated visual field defects

Classification of Glaucomas

- Open-angle glaucomas
- Angle-closure glaucomas
- Developmental glaucomas
- Glaucomas associated with other disorders

Open-Angle Glaucoma – Risk Factors

- Vertically elongated cup-to-disc ratios
- Asymmetric cup-to-disc ratios
- IOPs greater than 21 mm Hg
- Advancing age
- Black or Hispanic race
- Thin corneas
- Family history
- Medical history

Glaucoma Progression – Risk Factors

- Change over time in disc appearance, IOP, or visual field evaluation
- Optometrists and ophthalmologists with a low Index of Suspicion regarding their patients’ ability to develop glaucoma
- Optometrists and ophthalmologists who do not provide comprehensive care to all of their patients
- Optometrists and ophthalmologists who do not utilize advanced technology to assist in the diagnosis of glaucoma

Clinical Evaluation

- Ophthalmoscopy
- Fundus Photography
- Retinal Scanning Laser
- Visual Field Examination
- Intraocular Pressure
- Anterior Chamber Examination
- Patient History
- Visual Acuity
Ophthalmoscopy

63-year-old black female presenting for a “routine” eye examination.

Best corrected visual acuity = 20/20
Right eye IOP measures 18 mm Hg
Left eye IOP measures 20 mm Hg

Retinal Nerve Fiber Layer

- The retinal nerve fiber layer contains all of the retinal ganglion cells
- On direct visualization, its presence is best detected with red-free filters or photographs
- The RNFL normally has a striated appearance traversing across the major blood vessels
- Ocular or neurological disease can cause retinal nerve fiber layer defects
- The RNFL defects can be localized or diffuse
- RNFL defects can occur in glaucoma, optic disc drusen, optic pits, retinalchoroiditis, optic neuritis, compressive optic neuropathy and demyelinating disease

Red-Free Fundus Photography

Right Eye                                            Left Eye

Retinal Nerve Fiber Layer Defects

- Early, localized defects manifest as wedge-shaped dark areas with their apex at the optic disc
- Diffuse defects, found in more advanced disease, are characterized by complete baring of the large retinal blood vessels

Localized RNFL Defect

Scanning Laser Polarimetry

- Retinal nerve fiber layer analysis only
- Measures fallout of the retinal nerve fiber layer
- Output measures are compared to a normative database
- Performs TSNIT curve profile analysis
- Calculates the NFI number

Scanning Laser Polarimetry

The NFI number is a global measure based on a neural network that integrates large amounts of diverse data. The higher the number, the more likely glaucoma is present. Scores between 1-30 are often normal, patients scoring between 31-50 should be considered glaucoma suspects; and patients scoring over 50 tend to be glaucomatous.
In glaucoma, the superior and/or inferior RNFL humps are depressed or flattened. In addition, asymmetry in the TSNIT profile is often found in glaucoma.

**TSNIT Curve Profile Analysis**

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<th>Right Nerve Fiber Layer</th>
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**Deviation From Normative Database**

Normal Retinal Nerve Fiber Layer  
Abnormal RNFL with Wedge Defect

**Optical Coherence Tomography**

- Morphologic information on the structure of the retina and optic nerve
- Measurements of retinal thickness and optic nerve head parameters
- TSNIT graph presentation
- Quadrant plots for localized retinal defects
- Sector plots for focal retinal defects

**Visual Field Examination**

- Automated threshold perimeters measure the visual field by plotting the threshold luminance value of the patient in various locations in the visual field
- The luminance of the light stimulus is represented by non-specific units of measurement called decibels (db)
The diffuse loss of retinal sensitivity should be considered highly diagnostic of glaucoma if it is asymmetric and correlates with asymmetric changes in IOP, RNFL, or optic disc appearance.

- Mild Loss: -0.01 to -4.99 dB
- Moderate Loss: -5.00 to -9.99 dB
- Severe Loss: -10.00 dB and above

Glaucromatous Visual Field Defects

- Loss of Retinal Sensitivity
- Paracentral Scotomas
- Nasal Step Defects
- Hemifield Abnormalities
- Progressive Visual Field Loss

Paracentral Scotomas

- Focal visual field defects
- Small, isolated areas or points of reduced retinal sensitivity
- Typically centered beyond the central 10 degrees of fixation but usually within 20 degrees
- Estimated to occur in 70% of early glaucoma cases
**Hemifield Abnormalities**

- Superior arcuate scotoma
- Localized visual field defect that has a shape
- Multiple paracentral scotomas that have coalesced
- Indicates a focal notch of the optic disc that has reached the edge of the optic disc

**Anterior Chamber Examination**

- Gonioscopy technique
- Evaluate angle structures
- Estimate angle width
- Assess iris configuration
- Determine if there is an obstruction to the aqueous outflow mechanism
- Determine risk of angle closure
- Classify glaucoma type

**Intraocular Pressure**

- Average IOP is 15.5 mm Hg +/- 2.6 mm Hg
- Elevated IOP is a risk factor for glaucoma
- Increased IOP over time is abnormal
- Asymmetric IOP > 5 mm Hg is abnormal
- Diurnal variation > 6 mm Hg is abnormal
- According to the Early Manifest Glaucoma Trial, 20%-35% of glaucoma patients do not have elevated intraocular pressure

**Initiation of Treatment Program**

- Establish the diagnosis of glaucoma
- Classify the glaucoma by type
- Determine a category of glaucomatous damage
- Determine an initial target pressure range
- Prescribe treatment

**Open-Angle Glaucoma**

- 55-year-old black female presenting for a “routine” eye examination
- Best Corrected Acuity = 20/20
- IOP = 21 mm Hg
- Best Corrected Acuity = 20/20
- IOP = 24 mm Hg
Optical Coherence Tomography

- TSNIT curve analysis is abnormal due to significant asymmetry
- TSNIT curve is flat superiorly in the left eye
- Sector Plot analysis reveals moderate fallout of the retinal nerve fiber layer in the left eye

Visual Field Examination

- Left Eye
  - Nasal Step Defect
  - Glaucmatous visual field defect revealed on peripheral 60-4 threshold test
  - Abrupt difference in retinal sensitivity across the nasal horizontal meridian
  - Estimated to occur on about 18% of early glaucoma cases

- Right Eye

2nd Visit – Two weeks later

- IOPs are 24 and 29
- Gonioscopy performed
- Normal angle structures
- Normal iris configuration
- No excessive pigment
- No apparent obstruction to aqueous outflow mechanism
- Confirm glaucoma type
- Prescribe glaucoma drops

Anterior Chamber Evaluation

Open-Angle Glaucoma

- 44-year-old white female presenting for a “routine” eye examination
- Best Corrected Visual Acuity = 20/20
- IOP = 32 mm Hg
- Best Corrected Visual Acuity = 20/20
- IOP = 37 mm Hg

Optical Coherence Tomography

- TSNIT curve analysis is abnormal in both eyes
- Both TSNIT curves are flattened and the humps are depressed
- Sector Plot analysis reveals severe fallout of the retinal nerve fiber layer in both eyes
Visual Field Examination

Left Eye

Right Eye

Normal-Tension Glaucoma

56-year old black man presenting for a "routine examination"

Best Corrected Acuity = 20/20
IOP = 15 mm Hg

Best Corrected Acuity = 20/20
IOP = 16 mm Hg

Visual Field Examination

Left Eye

Right Eye

Visual Field Examination

Left Eye

Right Eye

Initiation of Treatment Program

- Prescribe prostaglandin eyedrop – set target range
  Next visit in three weeks
- IOPs are 11 and 13 – add combination eyedrop
  Next visit in three weeks
- IOPs are 8 and 8 – continue two-drop regimen
  Next visit in three months
- Treatment goal of a 50% reduction in intraocular pressure is achieved in six weeks

Normal-Tension Glaucoma

47-year-old black male presenting for a "routine" free eye examination

Best Corrected Acuity = 20/20
IOP = 13 mm Hg

Best Corrected Acuity = 20/20
IOP = 15 mm Hg
Optical Coherence Tomography

- TSNIT curve analysis is abnormal
- Left curve is flattened and both humps are depressed
- Sector plot analysis reveals severe fallout of the retinal nerve fiber layer of the left eye
- Clinically significant asymmetry

Visual Field Examination

- Inferior Nasal Step and Superior Arcuate Scotoma
- Normal Visual Field

Visual Field Examination

- Double arcuate scotoma
- 60-4 peripheral test reveals moderate glaucomatous damage in the left eye
- Glaucomatous visual field defects indicates focal notches at both poles of the optic disc

Initiation of Treatment Program

- Repeat all testing in one month
- IOPs at second visit are 14 and 17
- Test results identical to initial test results
- Prescribe prostaglandin eyedrop
- Acute red eye forces cessation of treatment after two days
- Wait one week for toxicity reaction to resolve
- Prescribe combination eyedrop
- Monitor compliance and effectiveness over time

Angle-Closure Glaucomas

- Relative pupillary block is the most common form
- Aqueous pressure behind the iris plane forces the iris forward
- Iris obstructs aqueous outflow mechanism
- Best treatment option is peripheral laser iridotomy

Convex Iris Plane Configuration

Angle-Closure Glaucomas

- Plateau iris syndrome
- Common cause of angle-closure in younger people (30-50 years)
- Iris is forced forward into the angle by an anteriorly positioned ciliary body
- Best treatment option is argon laser peripheral iridoplasty
Angle-Closure Glaucomas

- Lens-induced angle-closure
- Common cause of angle-closure in older people
- Increased lenticular thickness pushes the iris forward
- Best treatment option is cataract surgery

Glaucoma Studies

- The Baltimore Eye Study proved that glaucoma can be hard to diagnose.
- 50% of all people found to have glaucoma during the study had seen an eye doctor within the past year and were unaware that they had glaucoma.
- The Early Manifest Glaucoma Trial demonstrated that 50% of patients with glaucoma, even if they had elevated IOPs most of the time, had screening IOPs below 22 mm Hg.