Optic Disc Evaluation: Is the Optic Disc Glaucomatous and Has it Progressed?

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Lecture Objective

- To learn to identify the glaucomatous optic nerve and detect progressive glaucomatous optic disc damage.
Question 1

- All discs with a cup-to-disc ratio of .8 are glaucomatous
  - True
  - False
Question 2

Disc hemorrhages have no prognostic significance for glaucoma

- True
- False
Question 3

The most important characteristic to evaluate in the glaucomatous optic nerve is the color of the rim.

- True
- False
Question 4

All of the following are signs of optic disc progression EXCEPT:

- Notching
- Collateral development
- Vessel shifts
- Nerve fiber layer swelling
Goals of Optic Disc Evaluation

- Is there glaucomatous optic disc damage?
- Has there been ongoing glaucomatous optic disc progression
What is normal?

- Rim tissue composed of ganglion cell axons, glial tissue and blood vessels.

- Axons pass through the pores of the lamina cribrosa
Normal Optic Nerve

- Vertically oval
- ISN’T Rule
- C/D < 0.5

Armaly: Archives Ophthalmol 78, 1967
Assessment of Optic Disc

Is the disc glaucomatous? SHIP

- **S**ize
- **H**emorrhages
- **I**SN’T
- **P**arapapillary atrophy

**Bonus:** RNFL
Size Is Important

- Great variation in the size of the normal optic nerve.
Disc Size Is Important

- Size of cup varies with size of disc
- Large discs have large cups in healthy eyes
Jonas, Graefe’s 226: 332, 1998
Why is Disc Size Important?

- Size of the cup is linearly related to the size of the disc

Britton AJO 103: 499, 1987

Jonas, Graefe’s 226: 522, 198
Disc Size

Risk of not recognizing disc size:

- *Missing* the diagnosis of glaucoma in eyes with small optic discs.
- *Mis*-diagnosing glaucoma in eyes with large or asymmetric discs.
Small Optic Discs

- Easy to miss early cupping
- Even a small cup may be significant
- \(\beta\)-PPA is often the first finding
Small Optic Disc
Large Optic Nerve
Asymmetric Disc Size

Beware if asymmetric ‘cupping’
Techniques to Measure Disc Size

- **Direct ophthalmoscope**
  - 5° degree spot
  - 1.5 mm diameter
  - 1.8 mm²

- **Fundus Lens**
  - 90 diopter lens
  - Average 1.4 mm
  - Large > 1.6 mm
  - Small < 1.2 mm
Assessment of Optic Disc
Is the disc glaucomatous?

- **Size**
- **Hemorrhages**
- **ISN’T**
  - Focal Rim thinning
  - Generalized Rim thinning
  - Saucerization
- **Parapapillary atrophy**
- **Bonus:** RNFL
Generalized Concentric Loss

- Common form of cupping
- High IOP
- Normal visual field
Focal Loss

- Localized thinning of rim
- Inferior > superior
- Vertical elongation of cup
baseline

6 years later
Focal Loss

- May form acquired pit
- Earlier VF loss
- Associated with disc hemorrhage
Mixed Concentric and Focal

- Most common form of cupping
Pallor

- Sometimes seen in association with cupping.
- May be a marker of non-glaucomatous pathology.
- May be a marker of prior acute, transient IOP spikes.
Pallor

Often follows episodes of high IOP
Saucerized: Senile Sclerotic

- Pale saucerization
- Moth eaten rim
- Older patients
- Atherosclerotic disease
- $\beta$ - parapapillary atrophy
- Difficult to see changes
Myopic Tilted Discs

- May be difficult to interpret
- May have congenital VF abnormalities.
- Acquired VF defects may be adjacent to fixation.
Advanced Glaucomatous Disc Damage

- Excavation

- Exposure of the scleral insertion
  - the scleral ring of Elshnig.
Scleral Ring of Elschnig
Assessment of Optic Disc

Is the disc glaucomatous? SHIP

- Size
- Hemorrhages
- ISN’T
- Parapapillary atrophy

- Bonus: RNFL
Optic Disc Hemorrhages

- Giant red flag for progression
- Very specific for glaucoma damage.
- Most common in NTG
- IT > ST
- Transient, recurrent
Hemorrhages: DDx

- Posterior vitreous detachment
- Systemic disease
- Vascular occlusive disease
- Anticoagulation
Hemorrhages: Prognosis

- Increased rim loss --> notching
- Increased VF progression
- Increased RNFL defects
- Increased peripapillary atrophy
Detection and Prognostic Significance of Optic Disc Hemorrhages during the Ocular Hypertension Treatment Study

• Risk of developing POAG 6x greater in OHT eyes with DH

• Independent risk factor for glaucoma
  • 3.7x increase in risk in multivariate analysis independent of other significant baseline variables
Hemorrhages: Prognosis OHTS

- **8 year cumulative risk of POAG**
  - 5.2% in eyes without disc hemorrhage
  - 13.6% in eyes with disc hemorrhage

- **Patients with DH**
  - older
  - thinner corneas
  - larger baseline CDR

- **Only 16% of photographically documented DH were detected with dilated fundus exam!!!**
baseline

6 years later
Assessment of Optic Disc
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- **Bonus: RNFL**
Assessment of Optic Disc
Is the disc glaucomatous? **SHIP**

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**Bonus:** RNFL
Progression: What to look for?

- Thinning rim
- Widening notch
- Hemorrhages
- Vessel Shifts
- Increased $\beta$-Peripapillary atrophy
- Pallor
- Widening NFLD
Vessel Shifts and Rim Thinning

Baseline

8 years later

14 years later

Rim thinning, vessel shifts, widening
NFLD

baseline

14 years later
Increased B PPA

Baseline

8 years later
Vessel Shifts, Rim thinning
Collateral Development

baseline

23 years later
Collaterals

FIGURE 1. New venous collateral in the right optic nerve. (Left) Right optic disk in 1983. The inferotemporal vein drains into the central retinal vein (arrow depicts site of future venous obstruction). (Right) Right optic nerve in 1987. The inferotemporal vein at this point drains into a temporal collateral (large arrow). Note the loss of the connection between the inferotemporal vein and the central retinal vein (small arrow).

FIGURE 2. Disappearance of temporal collateral in the right optic nerve. (Left) Right optic nerve in 1991. There is narrowing of the temporal collateral (large arrow) and development of a collateral on the inferior optic nerve (small arrow). Note the progressive sclerosis of the inferotemporal artery. (Right) Right optic nerve in 1993. The temporal collateral circulation has almost resolved. The inferior retinal vein drains into the inferior collateral, and there is no direct connection to the central retinal vein. Also note that a similar process has taken place on the nasal disk with narrowing of a nasal vein (small arrow) and development of a nasal collateral (large arrow). There is also a suggestion that the inferior collateral may have developed a communication with the nasal venous drainage.

Compare Stereo Pairs

2004

2012
SHIP

- Size
- Heme
- Isn’t
- Peripapillary atrophy
- (RNFL)
SHIP

- Size
- Heme
- ISN’T
- Peripapillary atrophy
- (RNFL)
SHIP

- Size
- Heme
- ISN’T
- PPA
- (RNFL)
SHIP

- Size
- Heme
- ISN’T
- PPA
- (RNFL)
SHIP

- Size
- Heme
- ISN’T
- PPA
- (RNFL)
SHIP

- Size
- Heme
- ISN’T
- PPA
- (RNFL)
SHIP

- Size
- Heme
- Isn’t
- PPA
SHIP

- Size
- Heme
- Isn’t
- PPA
baseline

1 year later

S  normal
H  yes
I  thinning rim
P  none
S  yes

6 years later
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