Normal Tension Glaucoma

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Normal Tension Glaucoma (NTG)

➢ “A condition characterized by progressive optic nerve damage and visual field loss with a statistically normal intraocular pressure”
  - The Glaucoma Foundation

AOA Definition of Glaucoma

➢ A group of ocular diseases with various causes that ultimately are associated with a progressive optic neuropathy leading to loss of visual function.

AOA Optometric Clinical Practice Guideline: Care of the Patient with Open Angle Glaucoma. 2010 (3rd Edition)

Why do we consider NTG a stand alone topic?

➢ Etiology Challenge: are there non-IOP related mechanisms of NTG pathophysiology?
➢ Diagnostic Challenge: NTG can have unique presentation differences from POAG
➢ Management Challenge: NTG has unique treatment considerations that differ from POAG

Other pressures to consider in glaucoma

OXULAR PERFUSION PRESSURE (OPP)

OPP=Diastolic blood pressure (BP) minus Intraocular pressure (IOP)
Accepted Vascular Risk Factors of NTG

- Nocturnal Hypotension
- Vasospastic Disease (Migraine and Raynaud’s phenomenon)
- Sleep Apnea
- Hemodynamic Crisis
- Primary Vascular Dysregulation (PVD)

“Suspected” Vascular Risk Factors of NTG

- Carotid artery disease
- High cholesterol
- Hypercoagulation disorder
- Severe Anemia
- Cardiac Arrhythmia
- Blood Dyscrasias

Other pressures to consider in glaucoma

OCULAR PERFUSION PRESSURE (OPP)

OPP = Diastolic blood pressure (BP) minus Intraocular pressure (IOP)

References:

Ocular perfusion pressure (OPP) calculation:

OPP = Diastolic blood pressure (BP) minus Intraocular pressure (IOP)

Traslaminar pressure difference (TPD)

TPD = IOP (Intraocular Pressure) minus ICP (Intracranial Pressure)

References:
Clinical characteristics of NTG

- Saucer like cupping
- Drance hemorrhage
  - Prevalence of 25% in NTG vs. 8% in POAG*
- Visual field loss
  - Deeper, steeper scotoma
  - Closer to fixation


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Physiological Cup

- ONH
- CUP

Glaucmatous Cup

- ONH
- CUP

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Saucer-like Cupping

- Saucer like cupping
- Drance hemorrhage
  - Prevalence of 25% in NTG vs. 8% in POAG*
- Visual field loss
  - Deeper, steeper scotoma
  - Closer to fixation


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Drance Hemorrhage


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Physiological Cup

- ONH
- CUP

Saucer Cup

- ONH
- CUP
Clinical characteristics of NTG

- Saucer like cupping

- Drance hemorrhage
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- Visual field loss
  - Deeper, steeper scotoma
  - Closer to fixation

Schematic anatomy of retinal nerve fibers

Ganglion Cell Analysis

Can a glaucoma patient present with a paracentral scotoma?

Retrospective Study:
- A subset of 11 glaucoma patients presented with VF loss only on 10-2 that were not detectable by 24-2
- All patients had thinning on inferior and inferior temp macular OCT

Risk factors for presenting with a paracentral glaucomatous defect

- Drance Heme
- Migraine
- Low BP
- Sleep Apnea

1. Physiological/Anomalous Cupping

- IOP: Visit 1 OD: 16 OS: 16 @ 1:59PM
- Rx: OD: -6.75 - 4.50 x019 OS: -5.50 - 2.50 x145

- IOP:
  - Visit 1 OD: 16 OS: 16 @ 1:59PM
  - Visit 2 OD: 18 OS: 18 @ 8:55AM

- Pachymetry
  - OD: 530
  - OS: 520

- Hx: (-) FHx, migraine, apnea, HTN
  (-) hemodynamic crisis, trauma
  (+) hypercholesterolemia, (+) smoker

- Meds: Zocor, Evista

Case #1: 54 WF

- OD: 16 OS: 16 @ 1:59PM
- Rx: OD: -6.75 - 4.50 x019 OS: -5.50 - 2.50 x145

- OD: 18 OS: 18 @ 8:55AM

- Pachymetry
  - OD: 530
  - OS: 520

- Hx: (-) FHx, migraine, apnea, HTN
  (-) hemodynamic crisis, trauma
  (+) hypercholesterolemia, (+) smoker

- Meds: Zocor, Evista
Optic Disc Normal Database Values

Table 1: Descriptive statistics for each optic disc parameter, including the minimum value, maximum, median, mean and standard deviation.

<table>
<thead>
<tr>
<th>Disc Size Classification</th>
<th>Smallest 1/3 of Discs</th>
<th>Medium 1/3 of Discs</th>
<th>Largest 1/3 of Discs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disc Area</td>
<td>&lt; 1.58mm²</td>
<td>1.58mm² - 1.88mm²</td>
<td>&gt; 1.88mm²</td>
</tr>
</tbody>
</table>

Table 2: Arbitrary definitions of small, medium, and large disc areas from the normative database.

Differential Dx of NTG

2. Rule out “Red Disease”

Case #2: 46 WM

IOP: OD: 19
Pach: 580

OS: 18
Pach: 555

Case #2

"Axis Shift" From Malinserted Discs
"Axis Shift" From Malinserted Discs

Case #2: Axis Shift from Malinserted Nerves

Case #2: Axis Shift from Malinserted Nerves

"Axis Shift" From Malinserted Discs

Differential Dx of NTG

3. Rule out POAG with IOP masked by:
   - Thin CCT
   - Tx with systemic Beta-blocker
   - Diurnal IOP measurement

Take multiple IOP measurements at various times in the day!
4. Intermittent Angle Closure
   - Gonioscopy
   - Post dilation IOP

5. Rule out secondary glaucoma:
   - Pseudoexfoliative Glaucoma
   - Pigment Dispersion Syndrome
   - Previous Uveitic Glaucoma

6. Non-glaucomatous optic neuropathy conditions to rule out:
   - Ischemic optic neuropathy
   - Compressive optic neuropathy
   - Optic neuritis
   - Prior traumatic optic neuropathy

7. Other potential neurological concerns:
   - Intracranial space occupying lesion
   - Intracranial vascular infarct

Characteristics of non-glaucomatous neuropathy

- Unilateral
- Pallor-cupping
- ↓ VA, dyschromatopsia
- Visual field loss respecting vertical midline
- VF damage significantly worse than disc appearance
- Rapidly progressing VF or VA loss


Additional Workup for NTG

- Color Vision
- 10-2 Threshold Visual Fields
- Ganglion Cell Analysis
- Fundus Photos
- Corneal Hysteresis

What is Corneal Hysteresis?
- A biomechanical property of the cornea defining its ability to absorb and dissipate energy

Ocular Response Analyzer (ORA)
- CPT Code: 92145

What norms to use?
- <9 is considered a risk factor for conversion/progression
- 9-9.5 is considered suspicious for conversion/progression
- 10 is considered the normal/average value
- >11 is potentially protective against conversion/progression

Followed as a glaucoma suspect for 2 years
Risk Factors:
- FHx: sister
- Ocular Hypertension

IOP: Tmax OD 23 OS 22
Pach: OD 619 OS 609

OHTS Risk Factors for Conversion

CASE #3
Repeat RNFL consistent x 2 years

Followed as a glaucoma suspect for years
Risk Factors:
- FHx: sister
- Ocular Hypertension

Case #3: 72 BF
- IOP: Tmax OD 23 OS 22
- Pach: OD 619 OS 609
- CH: OD 8.3 OS 8.0
Collaborative Normal Tension Glaucoma Study (CNTGS)

**CNTGS Inclusion Criteria**
- Average IOP of ≤ 20mmHg
- No history of documented IOP > 24mmHg
- Open Angles
- No systemic β-blockers
- No other apparent cause for the optic neuropathy or visual field loss

**Progression of Disease:**
- 65% of randomized, untreated eyes did NOT show progression
- 35% of untreated eyes progressed compared to only 12% of treated eyes

**IOP reduction is beneficial to eyes at risk of progression**

**Risk factors for progression:**
- Disc Heme (2.72 greater risk)
- Migraine (2.58 greater risk)
- Female gender (1.85 greater risk)
- African ancestry???

**Confirmed non-risk factors for progression:**
- Baseline IOP
- Age
- FHx
- Hypertension

**Management of NTG**
- Don’t rush to treat
  - Many will not progress without treatment
  - Progression timeline is typically slow
- Check for progression over time (OCT, stereo disc photos and VF, both 24-2 and 10-2)
- Check IOP numerous times at various times of day to differentiate POAG
- Consider referral to test for: Sleep Apnea

**Treatment of NTG**
- Try to achieve 30% IOP reduction (Exp: 16mmHg → 11mmHg)
  - Difficult to do with meds alone
  - CNTGS: 43% of eyes required trabeculectomy to achieve 30% reduction
- Use PGs as first line meds
- Avoid Beta Blockers due to risk of decreased ocular perfusion
- Brimonidine may have neuroprotective capability

**Low Tension Glaucoma Treatment Study (LoGTS)**

**Is brimonidine Neuroprotective?**
- Tested effectiveness of 0.2% brimonidine BID vs. 0.5% timolol BID over a 2.5 year period
- Showed equal drop in IOP
- Progression of VF Loss
  - 9.1% of brimonidine treated patients progressed
  - 39.2% of timolol treated patients progressed
Low Tension Glaucoma Treatment Study (LoGTS)

Is brimonidine Neuroprotective?
- Further analysis showed no relationship between IOP and VF progression.
- However, both systemic beta blocker use and lower mean ocular perfusion pressure were significant risk factors for VF progression.
- Brimonidine effect on VF was independent of ocular perfusion pressure and blood flow.

Non-ocular management of NTG
- Management recommendations to limit reductions in ocular perfusion pressure:
  - Consider 24hr BP monitoring
  - Avoid Beta blockers for HTN therapy
  - Avoid nighttime dosing of any HTN therapy
  - “Salt load” before bedtime
  - Semi-reclined sleeping position

Treatment of NTG
- Rho-kinase inhibitors as additive to PGs
- Other possibilities to enhance ONH bloodflow??
  - Topical CAIs may improve peripapillary blood flow
  - Oral Calcium channel blockers
  - Gingko Biloba

Thank You!