Understanding Glaucoma

Elective Course: Clinical Ophthalmology

For Medical Students, State University of New York at Stony Brook
Glaucoma Awareness

- What is glaucoma?
- Why do we care so much about glaucoma?
- Who is at risk for developing glaucoma?
- How do I recognize glaucoma?
- How is glaucoma treated?
- What should I know about treatment side effects?
Glaucoma

- A group of diseases with characteristic damage to
  - the optic nerve (structural damage)
  - the visual field (functional damage)
- Commonly, but not always, associated with a high intraocular pressure
Glaucoma occurs when there is an abnormal increase in pressure within the eye. This can lead to damage to the optic nerve and loss of vision. The diagram shows a normal eye and a glaucoma eye with pressure buildup.

Key structures labeled in the diagram:
- Sclera
- Choroid
- Vitreous Body
- Ciliary Body and Muscle
- Fovea Centralis in Macula
- Iris
- Lens
- Cornea
- Optic Nerve
- Trabecular Meshwork
- Build Up of Aqueous Humor Fluid

The normal eye is compared to the eye with glaucoma, highlighting the increased pressure and resulting damage.
Optic Nerve Head
Optic Nerve Head Anatomy

Figure 4.1. Divisions of the optic nerve head. A: Surface nerve fiber layer. B: Prelaminar region. C: Lamina cribrosa region. D: Retrolaminar region.

Glaucomatous Optic Atrophy: Histological vs. Clinical Anatomy
| Side Vision | Fine Vision | Side Vision |
Relating the Visual Field to the Fundus
Visual field loss in glaucoma reflects the pattern of nerve fiber layer loss.
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World-wide Causes of Blindness

- Cataract: 30%
- Refractive Error: 18%
- Glaucoma: 8%
- AMD: 6%
- Diabetic Retinopathy: 1%
- Corneal Opacity: 3%
- Trachoma: 1%
- Other: 33%

World-Wide Glaucoma

- 2020: 76 million
- 2040: 111.8 million
- Global prevalence total: 3.54%
- Global prevalence (POAG): 2.2% (approx. 57.5 million)

- Bilateral blindness from glaucoma:
  - 4.5 million in 2010
  - 11 million in 2020
Glaucoma Epidemiology in the USA

• Over 3 million Americans affected (2020 estimate)
• Second most prevalent cause of US blindness overall
• Most important cause of blindness in African Americans (up to 25% of all blindness is from glaucoma)
• Half of glaucoma patients are probably unaware they have the disease
• Early Diagnosis is the key
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High Risk Patients for Glaucoma

• Increasing age
• Family history of glaucoma
• Race, relative predispositions
  – African or Afro-Carribean descent: open-angle glaucoma
    • Blindness 5x more common than in Caucasians, 10% prevalence in >70yo age-group
    • Progresses more rapidly, more advanced stage and earlier age when discovered
  – Asians, Eskimos: narrow angle glaucoma
• Refractive errors
  – Myopia (nearsightedness): open-angle glaucoma
  – Hyperopia (farsightedness), especially more extreme degrees: narrow-glaucoma
• Vascular disease; Diabetes (?)
Screening for Glaucoma

• Typical approach: intraocular pressure screening
• Detects < 50% of glaucoma patients
  – Diurnal fluctuations in intraocular pressure
  – “Normal” tension glaucoma
  – Inaccurate pressure readings
• >70% of patients with suspicious intraocular pressures will not have glaucoma
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Recognizing Glaucoma

• Open-angle glaucoma
• Closed-angle (narrow-angle) glaucoma
• Congenital glaucoma
Suspicious Cupping

- **Size:**
  >0.6 times the disc diameter

- **Shape:**
  Diffusely enlarged
  Focal enlargement - notching

- **Right-left asymmetry:**
  >0.1 disc diameters

- **Superficial hemorrhages at disc margin**
Asymmetric Optic Disc Cupping
Glaucomatous Optic Atrophy: Focal Atrophy
Glaucomatous Optic Atrophy: Disc Hemorrhages
Abnormal Optic Disc Cupping
Nerve Fiber Layer Loss in Glaucoma
Pathophysiology of Elevated Intraocular Pressure

• Impaired aqueous humor outflow
• Three major mechanisms
  – **Open-angle glaucoma**: cellular or functional abnormality in trabecular meshwork region
  – **Angle closure glaucoma**: obstruction by the iris
  – **Congenital glaucoma**: developmental angle anomaly
The Angle
Acute Angle-Closure Glaucoma

- Severe eye pain
- Headache
- Red eye – ciliary flush
- Corneal haze
- Fixed mid-dilated pupil
- Blurred Vision
- Halos around lights
- Nausea and vomiting
Precipitating Acute Angle Closure Glaucoma

- Narrow anterior chamber angles predispose to acute angle closure glaucoma
- Pupil dilation can precipitate acute angle closure glaucoma
  - Topical drops: muscarinic antagonists, alpha adrenergic receptor agonists
  - Systemic medications: with similar actions, including antihistamines, anti-Parkinson drugs, anti-psychotics, GI spasmolytic agents, etc.
- Dim illumination
- Emotional stress
Congenital Glaucoma

Presenting signs: large cloudy cornea, high intraocular pressures, tearing, blepharospasm
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Treating Glaucoma

• Medications – topical & systemic (oral)
  – Many medications available
  – Dosage: 1, 2, 3, 4 times a day
  – Regimen: single, multiple
  – Many drug classes and mechanisms of action

• Laser treatment
  – Open angle – trabeculoplasty
  – Narrow angle- peripheral iridotommy
  – Either - cyclophotocoagulation

• Surgery
Open-Angle Glaucoma:
Laser Therapy
Angle-Closure Glaucoma - Iridectomy
Glaucoma Surgery

Filtration surgery: most common approach
- channel from anterior chamber to subconjunctival space

bleb
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## Topical Anti-glaucoma Drugs: Systemic Side Effects

<table>
<thead>
<tr>
<th>Beta Adrenergic Receptor Blockers</th>
<th>Adrenergic Receptor Agonists</th>
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</thead>
<tbody>
<tr>
<td>Congestive heart failure</td>
<td>Increased BP</td>
</tr>
<tr>
<td>Brochospasm</td>
<td>Tachyarrhythmias</td>
</tr>
<tr>
<td>Bradycardia</td>
<td>Tremor</td>
</tr>
<tr>
<td>Depression, confusion</td>
<td>Headache</td>
</tr>
<tr>
<td>Impotence</td>
<td>Anxiety</td>
</tr>
<tr>
<td>Worsening of myasthenia gravis</td>
<td></td>
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Topical Anti-glaucoma Drugs: Systemic Side Effects/Contraindications

**Carbonic Anhydrase Inhibitors**
- Transient: paresthesia, urinary frequency
- Metallic taste in the mouth
- Urolithiasis
- GI upset
- Hypokalemia
- Blood dyscrasia
- Rare systemic effects with topicals
- Sulfa allergy
- Sickle cell

**Parasympathetics**
- Rare with standard doses
- Diaphoresis
- Pulmonary edema
- Leukocytosis
- Bronchospasm
Topical Anti-glaucoma Drugs: Systemic Side Effects

**Prostaglandins**
- Eyelash growth
- Darker iris color
- Hyperpigmentation of skin around eyes
- Orbital fat atrophy
- Not to be used in pregnancy

**Rho Kinase inhibitors** *(Rhopressa/netarsudil)*
- Injection
- Verticillata
Topical Corticosteroid Drops

- Complications – any age
  - Increased intraocular pressure
    - Glaucoma patients
    - Relatives of glaucoma patients
    - Many others
  - Corneal infections
    - Reactivating latent herpes simplex
    - Bacterial
  - Cataracts
- Same complications from systemic use
- Do NOT prescribe topical corticosteroids unless you are prepared to diagnose and treat their complications
- For all eye drops: Allergy, redness, blurring, stinging, dryness
Glaucoma Awareness

- Complex, under-diagnosed but common blinding diseases.
- Pay attention to the optic disc cup, or to the neurosensory rim of the disc.
- Eye drops are systemic medications.
- Systemic medications can affect the eye.
- Only ophthalmologists should prescribe topical corticosteroids.
- Encourage periodic routine eye exams.