The Secondary Glaucomas

Danica J. Marrelli, OD, FAAO
University of Houston College of Optometry

Financial Disclosure:

- Aerie Pharmaceuticals
- Allergan
- Bausch & Lomb
- Carl Zeiss Meditec
- Ivantis
- Kala
- Santen

Differences with Secondary Glaucomas

- Diagnosis:
  - Laterality
  - Presentation (acute vs insidious)
  - Other clinical findings
- Management – treat the CAUSE, if possible
  - Medications: contraindications, effectiveness
  - Lasers: differences in response

Secondary Glaucomas

Secondary <u>OPEN</u> Angle

- Exfoliation
- Pigmentary
- Lens-induced
  - Phacolytic
  - Lens Particle
  - Phakoanaphylaxis
- Inflammatory
  - Uveitic
  - Glaucomatocyclitic Crisis
  - Fuch's Heterochromic Iridocyclitis
- Steroid-induced
- Elevated EVP
- Traumatic
  - Hyphema
  - Angle Recession

Secondary <u>ANGLE CLOSURE</u>

- With Pupillary Block
  - Lens-induced
    - Phacomorphic
    - Ectopia Lentis
- Without Pupillary Block
  - Anterior Pulling
    - Neovascular
    - Iridocorneal Endothelial Syndrome
    - Inflammatory
  - Posterior Pushing
    - Aqueous Misdirection
    - Drug-Induced

SECONDARY OPEN ANGLE GLAUCOMAS

Exfoliation Syndrome (Pseudoexfoliation)

- Characterized by deposition of amyloid-like fibrillary material throughout anterior segment
  - Anterior lens capsule
  - Pupil margin
  - Lens zonules
  - Corneal endothelium
  - Inferior angle (gonioscopy)
- Iris transillumination at pupil margin
- Heavy dark pigment in TM, +/- Sampaolesi's line
- Weakened zonules -> phacodonesis, iridodonesis

Exfoliation Syndrome

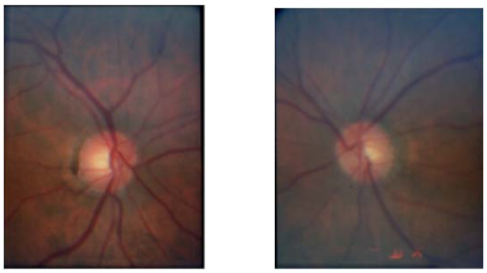
- Strongly age-related; rare under 50 yo
- May be MONOCULAR or binocular with asymmetry in presentation and timing
- GLAUCOMA
  - Thought to be due to TM obstruction and subsequent damage/dysfunction
  - Odds ~ 40% over a 10-year time frame
  - Scandinavian countries: Exfoliation accounts for >50% of open angle glaucoma
- Differences between exfoliation glaucoma and POAG:
  - Often presents monocularly
  - Greater IOP fluctuations
  - Overall WORSE prognosis

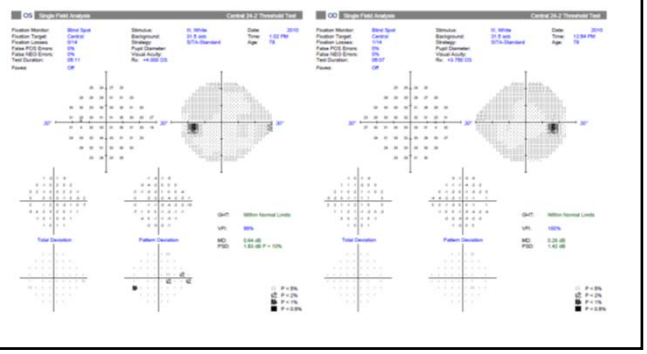
Exfoliation Syndrome

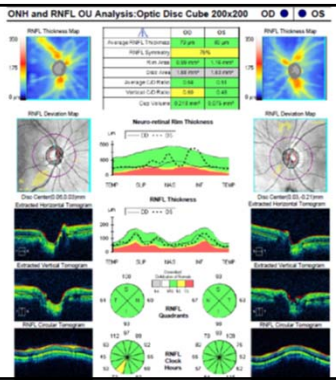
- Management:
  - Similar to POAG (meds)
  - SLT can be very effective
    - Power may be lessened, or treat only part of angle
    - Effect may not last as long as with POAG
- CATARACT SURGERY:
  - Lens extraction does NOT alleviate condition
  - Weakened zonules – higher risk of lens dislocation during/after surgery
  - Increased inflammation after all intraocular surgeries compared to POAG

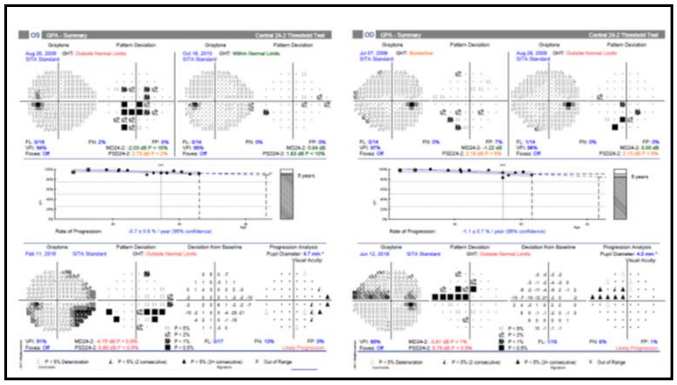
Mr. Garcia, 86 yo HM

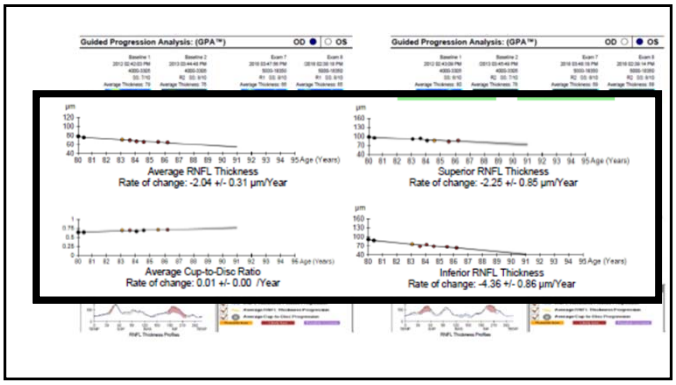
- Followed as glaucoma suspect from 2008-2012 (pseudoexfoliation)
- Untreated IOP 14-18mmHg OU
- 2012: IOP began to be elevated, Tmax 25mmHg
  - Treatment initiated with Latanoprost 2012

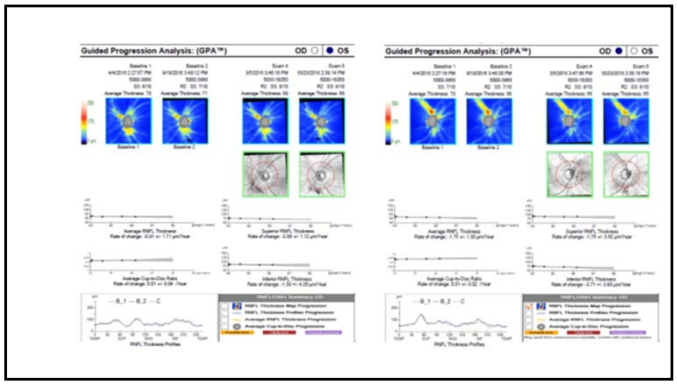


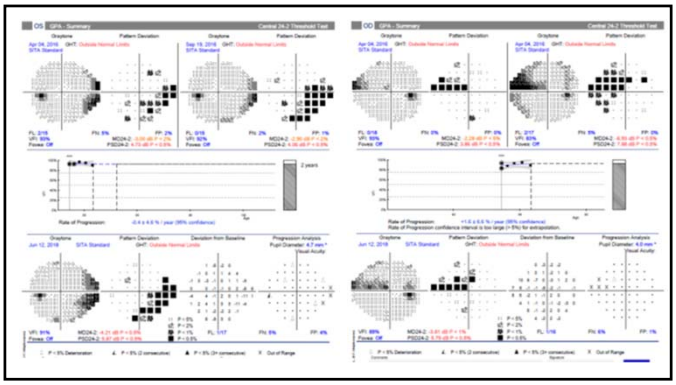












Pigmentary Glaucoma

- Pigment Dispersion Syndrome (PDS)
  - Pigment on corneal endothelium (Krukenberg Spindle)
  - Iris transillumination defects in spoke-like pattern (mid-periphery)
  - Homogenous heavy pigmentation in TM / speckled pigment ant to SL

  - Additional pigment: zonules, ant/post lens surface
  - Midperipheral iris is often concave (bowing toward zonules)

Pigmentary Glaucoma

- PDS does not universally lead to glaucoma
  - 25-50% risk
  - Glaucoma develops most commonly in myopic males between 20-50 yo
- Characterized by WIDE fluctuations in IOP, often after pigment release
  - Exercise, pupillary dilation
  - May complain of blur or pain during episodes

Pigmentary Glaucoma

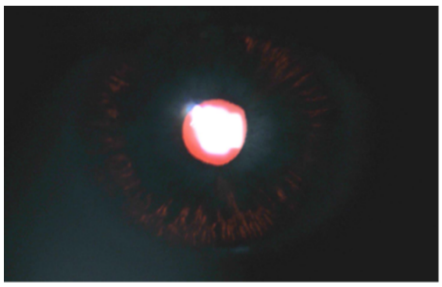
- TREATMENT:
  - Standard medical therapy
  - Peripheral laser iridotomy or iridoplasty – proposed to alter iris configuration and decrease peripheral iris rubbing on zonules (not well established as a treatment)
  - SLT: higher risk of IOP spike than POAG
- With age, TM pigment may fade away as mechanism of pigment dispersion decreases

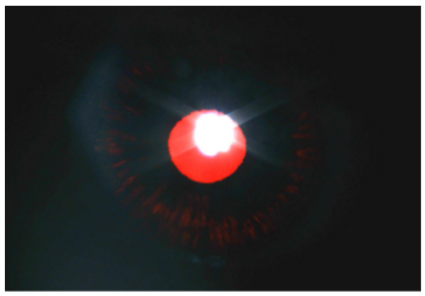
Case: Kevin, 25 year old white male

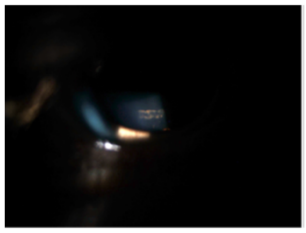
- CC: Wants some new soft CLs, time for exam
- HPI: High myopia (-7.50 OU), wears daily wear SCL, monthly disposable lenses, no problems
- POH: Unremarkable, (-) surg/trauma
- PMH: "Very healthy", (-) chronic illnesses, surgeries, hospitalizations
- FH: Unremarkable
- Meds: None
- Allergies: NKDA
- Social: Occasional alcohol, no smoking

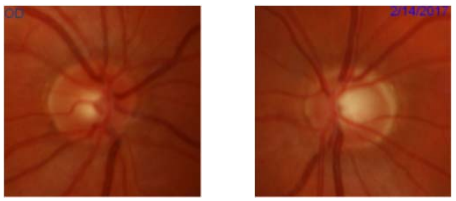
Exam Data

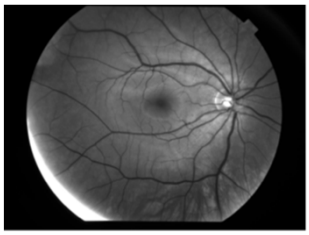
- BCVA: 20/20 OD, OS
- Motility: Full OU
- Pupils: 5mm OD/OS, 3+ D/C, (-) RAPD
- SLE: See photos
- IOP: 21mmHg OD 38mmHg OS
- Gonioscopy: See photos
- DFE/VF

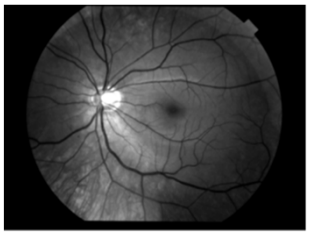


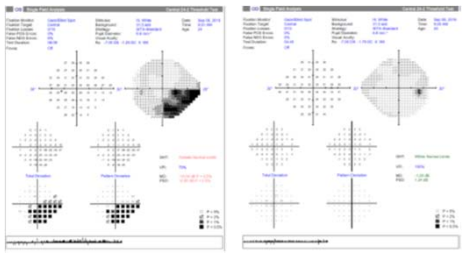


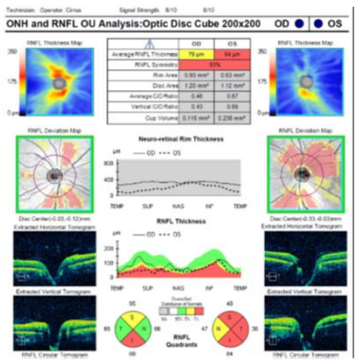


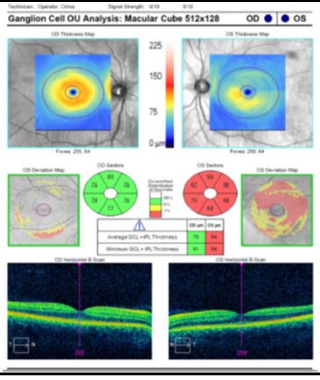












How Do We Treat?

- PGA?
- Beta Blocker?
- Brimonidine?
- CAI?
- Laser?

- Final disposition

Lens-induced OPEN ANGLE Glaucoma

- Phacolytic: Inflammatory open angle glaucoma caused by leaking proteins through capsule of mature cataract
  - Sudden onset pain, conjunctival hyperemia, vision loss
  - Markedly elevated IOP
  - Corneal edema
  - Anterior chamber reaction WITHOUT KP (*** helps to differentiate from phacoanaphylaxis); may layer into hypopyon
  - Wrinkled capsule of hypermature cataract
  - TREATMENT: Acute management to lower IOP, then surgery

Lens-induced OPEN ANGLE Glaucoma

- Lens Particle:
  - Cortical material left in AC after surgery
  - Present with visible cortical material in AC, AC reaction, posterior synechiae
  - TREATMENT: mydriatic, corticosteroid, aqueous suppressants, occ. Surgery
- Phacoanaphylaxis: RARE
  - Patient becomes sensitized to their own lens protein following penetrating injury or surgery
  - GRANULOMATOUS inflammation with KP, vitritis, synechiae
  - Glaucoma is uncommon
  - Treat with corticosteroid and aqueous suppressants

Inflammatory OPEN ANGLE Glaucoma

- Inflammation can cause secondary glaucoma that has both open- and closed-angle components
- Uveitis: Elevated IOP can occur due to a variety of mechanisms
  - Trabeculitis
  - TM endothelial dysfunction
  - TM blocked by fibrin and cellular debris
  - Steroid-induced resistance to outflow

Inflammatory Open-Angle Glaucoma: The DILEMMA

- Often difficult to establish cause of elevated IOP
- Inadequately controlled inflammation with elevated IOP is often mistaken for steroid-induced glaucoma
  - Presence of AC reaction: presume that inflammation is cause (increase steroid)
  - Timing may help (steroid-induced IOP elevation takes time)
- TREATMENT:
  - Control inflammation
  - Aqueous suppressants
  - NO PILOCARPINE, no SLT
  - ? Use of prostaglandin analogs

Inflammatory: Glaucomatocyclitic Crisis

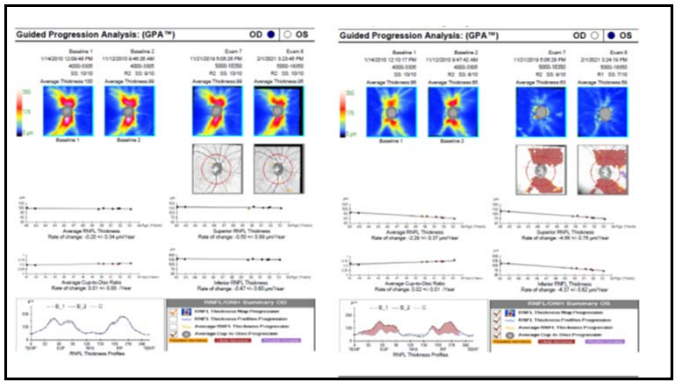
- AKA Posner-Schlossman Syndrome
- Uncommon, episodic, unilateral open angle inflammation with markedly elevated IOP and low grade AC reaction
- Pt presents with mild symptoms
- Exam reveals mild AC reaction, few small discrete KP
- IOP 40-50mmHg, may have corneal edeam
- In between attacks, inflammation resolves and IOP returns to normal
- Differential: intermittent angle closure (GONIOSCOPY!!!)

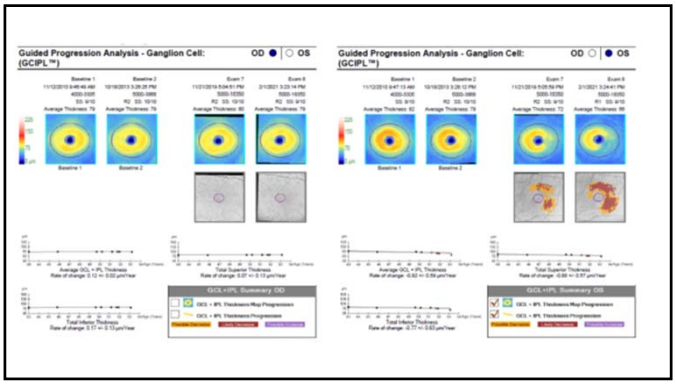
Glaucomatocyclitic Crisis

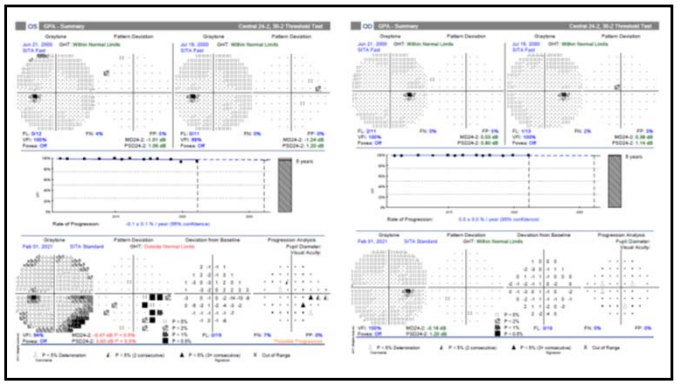
- TREAMENT:
  - No evidence that chronic suppressive treatment helps
  - Treat each episode with corticosteroid and aqueous suppressants
  - Consider oral antiviral (HZV, HSV have been implicated)
  - Secondary glaucoma may develop with repeated attacks
    - BASELINE VF, OCT are helpful

Jackie, 54 year old Asian Female

- H/O initial presentation of glaucomatocyclitic crisis in 1994 OS
  - Blur and mild discomfort OS x 2 days
  - IOP 47mmHg OS, trace cell and single small KP
  - Treated with corticosteroid and timolol, complete resolution
- Initially had episode about 2x/year, but became more frequent in early 2000s
  - Sent to uveitis specialist who performed AC tap, (+) HSV
  - Oral acyclovir at therapeutic dose followed by prophylactic dose
  - Despite acyclovir, continued to have multiple episodes per year, sometimes as often as every 2 months







Inflammatory: Fuch's Heterochromic Iridocyclitis

- Rare, UNILATERAL low grade chronic iridocyclitis with iris heterochromia (lighter on involved side)
- Clinically:
  - Low grade AC reaction
  - Small stellate KP
  - PSC
  - Fine blood vessels on gonioscopy that do not lead to PAS
- Insidious onset in middle age, females > males
- OAG in 15% of cases
  - Glaucoma does not correlate with degree of inflammation
  - Can be difficult to control

Elevated Episcleral Venous Pressure

- Normal EVP is 8-10mmHg; can be elevated by a variety of conditions that block venous outflow (unilateral or bilater)
  - Carotid cavernous fistula
  - Orbital varix
  - Sturge-Weber syndrome
  - Retrobulbar mass
  - Thyroid Ophthalmopathy
- ****Key clinical finding is dilated tortuous episcleral veins
- Gonioscopy: blood in Schlemm's canal
- Treatment:
  - aqueous suppressants, PGAs
  - SLT ineffective
  - Surgical complication risk: ciliochoroidal effusion, suprachoroidal hemorrhage

Case: Why Are My Eyes STILL Red?

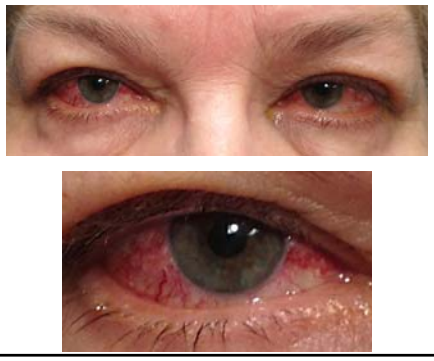
- 60yo HF presents complaining of worsening red eyes
- HPI:
  - (-) photophobia or eye pain
  - (+) itching & tearing
  - Diplopia "periodically" x 2 months
  - Most recent diagnosis was unspecified conjunctivitis WITH CNVI palsy due to DM

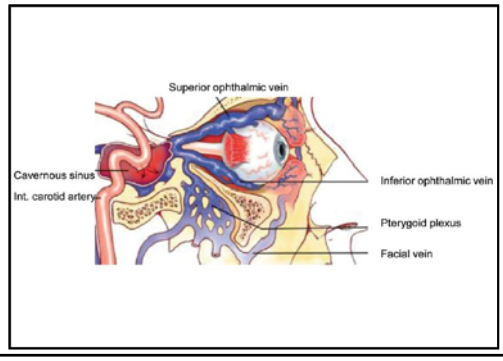
Patient History

- POH: Unremarkable
- PMH: DM2 x 4 years; HTN
  - Recent hospitalization due to severe HA
- FHx: non-contributory
- Meds: Benicar®, metformin
- All: None
- Social: No tobacco/alcohol

Examination:

- VA: 20/20 OD, OS
- Pupils: equal, round, 3+D/C, (-) RAPD
- Motility: abduction deficit OU
- Slit lamp:
  - L/L/L – normal
  - Conj – 4+ hyperemia with corkscrew vessels, chemosis
  - Clear cornea, AC
- IOP: 32mmHg OD 24mmHg OS
- DFE: Normal DMVP OU





Traumatic Glaucoma

- Elevated IOP can occur due to inflammation, blood and RBCs, and direct injury to TM
- HYPHEMA:
- Several mechanisms for elevated IOP
  - Re-bleed
  - RBCs obstructing TM
  - Sickle cell hemoglobinopathies: RBCs tend to sickle in AC, making it harder to pass through TM
- Uncomplicated hyphema: manage conservatively
- If increased IOP: aqueous suppressants (avoid CAI in sickle cell)
- AC washout may be needed if IOP elevated too high or too long

Angle Recession Glaucoma

- Angle recession: cleavage/tear between circular and longitudinal muscles of CB
- Often associated with direct TM damage, as well
- Gonioscopy:
  - Broad angle recession
  - Absent or torn iris processes
  - White glistening scleral spur
  - Depression of overlying TM
  - Localized PAS at edge of recession

Angle Recession Glaucoma

- Chronic UNILATERAL glaucoma that can occur years to months after injury
- A significant portion of fellow eyes (50%) will develop increased IOP, suggesting predisposition to develop glaucoma
- Risk of glaucoma increases with degree of angle recession
- Risk if LIFELONG
  - Baseline OCT, VF, photos helpful after injury
- Treatment:
  - Medical: TM outflow agents not likely effective
  - Laser trabeculoplasty of limited value/success

SECONDARY ANGLE CLOSURE GLAUCOMAS

Secondary Angle Closure WITH Pupillary Block

- Lens-induced
- Phacomorphic: much more rapid development than primary angle closure with pupillary block
  - Lens swelling in eye not pre-disposed to angle closure
  - Difference in AC depth
  - Difference in cataract
- Ectopia Lentis:
  - Trauma
  - Marfan Syndrome
  - Homcystinuria
  - Microspherophakia
  - *Exfoliation syndrome

TREATMENT: REMOVE LENS

Secondary Angle Closure WITHOUT Pupillary Block

- Two mechanisms for Secondary Angle Closure without pupillary block:
  - Contraction of inflammatory, hemorrhagic, or vascular membrane in angle -> PAS
    - NVG
    - ICE Syndrome
  - Forward displacement of lens-iris diaphragm, often accompanied by swelling and anterior rotation of ciliary body
    - Aqueous misdirection
    - Drug-induced

Neovascular Glaucoma

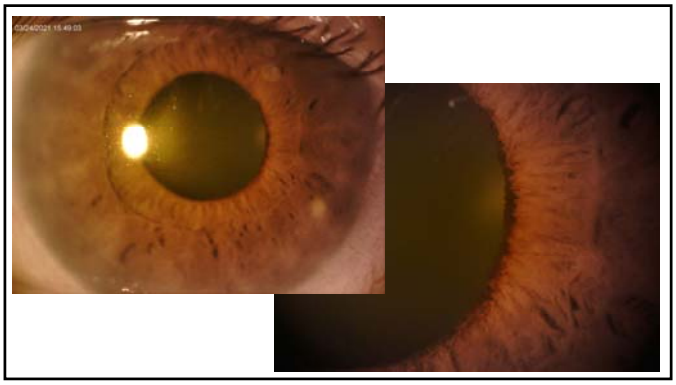
- Most commonly associated with proliferative diabetic retinopathy, CRVO, and ocular ischemic syndrome
- Clinical presentation:
  - Often acute onset of pain and decreased vision
  - Conjunctival injection, microcystic corneal edema, high IOP
  - GONIOSCOPY: neovascularization in TM, PAS that stop at SL**
  - Typically have visible retinal cause
    - If no obvious cause, consider carotid occlusive disease

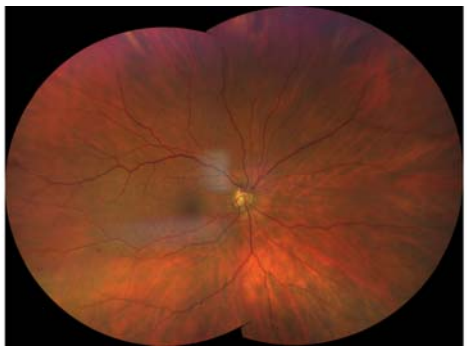
Neovascular Glaucoma

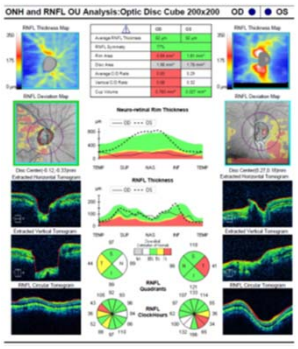
- Management:
  - Acute: aqueous suppressants (often need oral CAI) will not be sufficient
  - Urgent referral for anti-VEGF and panretinal photocoagulation or other retinal ablation
  - Retinal ablation markedly decreases neovascularization, but IOP may remain elevated depending on PAS
  - Trabeculectomy or tube shunt often needed to control IOP
  - Cryoablation if tube/trab fails
- VERY POOR PROGNOSIS – early detection is key

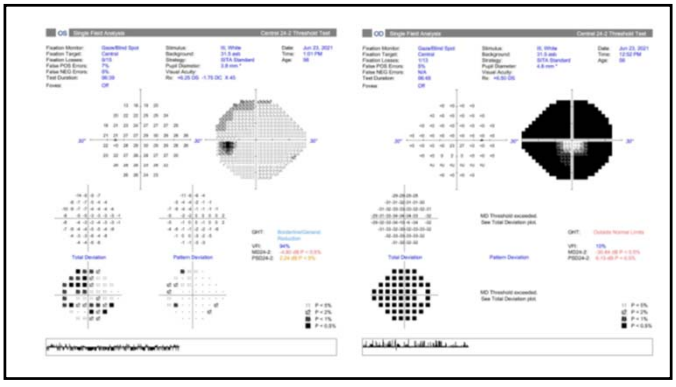
Case: Gloria, 57yo HF

- CC: Pain and blurred vision OD for several *months*
- Ocular History: Unremarkable
- Med Hx:
  - Type 2 DM (A1C 6.5%)
  - Systemic hypertension (108/68)
  - Rheumatoid arthritis
- Exam:
  - BCVA: 20/50- OD 20/20 OS
  - Pupils: 4mm OU, sluggish reaction, (+) RAPD OD
  - SLE: microcystic edema OD, NVI OU
  - IOP: 51mmHg OD, 26mmHg OS
  - Gonioscopy: difficult due to K edema; multiple areas large PAS OD only (open to SS OS without neovascularization or PAS









Final disposition…

Iridocorneal Endothelial (ICE) Syndromes

- Characterized by abnormal corneal endothelium, varying degrees of iris atrophy, and secondary glaucoma
- UNILATERAL, found in 20-50 year old age range, women>men
- In EACH syndrome, corneal endothelium has "beaten metal" appearance similar to Fuch's endothelial dystrophy AND "high" PAS (anterior to SL) – the PAS can help to separate from uveitic and NV
- Degree of PAS does not correlate with elevated IOP
- Varying degrees of iris atrophy and corneal changes separate the 3 types

Iridocorneal Endothelial (ICE) Syndromes

- Progressive Iris Atrophy:
  - Severe iris atrophy with heterochromia and ectropion uveae, iris stromal and pigment epithelial atrophy, iris holes
- Chandler: MOST COMMON of the ICE syndromes; minimal iris atrophy and corectopia; corneal and angle findings predominate
- Cogan-Reese: less severe iris atrophy; tan pedunculated nodules or diffuse pigmented lesions on anterior iris surface

ICE Syndromes - Glaucoma

- Glaucoma occurs in 50% of ICE syndrome patients
  - Glaucoma tends to be worse in Progressive Iris Atrophy and Cogan-Reese
- MUST ALWAYS THINK OF ICE in young to middle-aged patient with UNILATERAL angle closure glaucoma
  - Specular microscopy can reveal asymmetric endothelial loss and highly atypical morphology of involved eye's corneal endothelium
- Treatment geared toward managing corneal edema and IOP
  - Trabecular outflow drugs not effective
  - Laser trabeculoplasty not effective

Aqueous Misdirection

- AKA "malignant glaucoma" and "ciliary block" glaucoma
- Usually presents following intraocular surgery in patient with h/o angle closure glaucoma or PAS, -OR- in open angle glaucoma patient after cataract surgery
- ACUTE presentation with UNIFORM flattening/shallowing of anterior chamber and elevated IOP
- Thought to result from anterior rotation of CB and misdirection of aqueous in association with relative block of aqueous movement at the level of the lens equator, vitreous face, and CB processes

Aqueous Misdirection

- Management:
  - Intensive cycloplegic
  - Aqueous suppressants
  - YAG laser to vitreous face
  - May require return to OR

Drug-Induced Secondary Angle Closure

- Most common: topiramate (Topamax, Trokendi, Qsymia)
  - Has also been reported with acetazolamide
- Clinical Presentation:
  - Acute myopic shift >6D
  - BILATERAL angle closure with uniformly shallow/flat AC
  - Usually occurs within 1 month of initiation of topiramate therapy
- MANAGEMENT: DIFFERENT THAN PRIMARY ANGLE CLOSURE!!!!
  - Immediate d/c topiramate
  - Strong cycloplege (NOT pilocarpine!!!)
  - Aqueous suppressants (avoid oral CAI)
  - Corticosteroid
  - Resolves in 24-48 hours

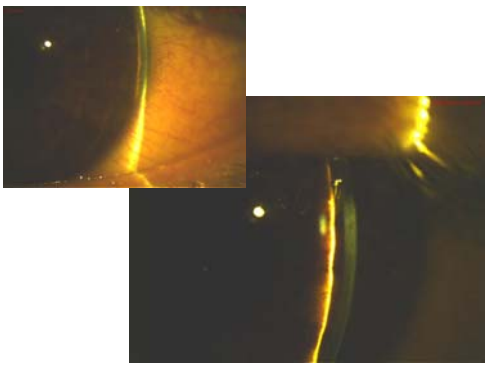
"My Eye Hurts & I Can't See"

- CC: 28 YO WF presented with blurry vision OU, seeing rainbows around lights, severe frontal HA, and nausea for one day
- Ocular History: unremarkable, 5D Myope OU (DWSCL)
- Medical History: (+) HA, Tremors, Dizziness – currently under care of neurologist for evaluation/management
- Family Ocular/Medical History: unremarkable
- Medications: new med for neurologic symptoms (unknown name) x 8 days; acetaminophen prn for HA (no relief)
- Allergies: Codeine
- Social History: unremarkable

Clinical Exam

- VA w/glasses: 20/100 OD and OS, PH – 20/40 OD, OS
- Pupils: 4mm OU, sluggish reaction OU
- Motility normal OU
- SLE:
  - 1+ diffuse Corneal Edema OU
  - Closed angles OU (Van Herrick)
  - Shallow anterior chambers OU
- IOP: 34 OD, 35 OS @ 2:15 pm

Due to nausea & vomiting, unable to perform gonioscopy at initial visit



Treatment:

- Immediate Therapy (In Office)
  - Two doses of scopolamine OU, topical steroid, and Combigan®
  - IOP reduced to 20mmHg OD and 26mmHg OS
  - Discharged with Combigan® and pga
  - D/C Topamax®
- Follow-up (24 h):
  - VA still blurry (no haloes), no pain
  - VA: 20/25 OD, OS through -10.00DS
  - IOP: 10mmHg OD , 12mmHg OS
- Follow-up (Day 4):
  - VA 20/20 through habitual (-5D) spectacles
  - IOP 10mmHg OU
  - D/C all topical meds