



Glaucoma Grand Rounds


Elizabeth D. Muckley, O.D., F.A.A.O.
 Director of Optometric Services NE Ohio Eye Surgeons
 Kent - Slow - Akron
 Emuckley@midwestvision.com



Disclosures


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- Consultant, Allergan Pharmaceuticals
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So you diagnosed glaucoma, now what?

Case 1



- 63 yr. old Caucasian Male referred for glaucoma evaluation
 - IOPs on referral form were 18mmHg OD/21mmHg OS Tonopen, no time of day noted
 - Significance of Tonopen and time of day?
 - MR on referral form was OD: plano +2.75 x 090 20/20
OS: -0.50 +2.00 x 85 20/20
 - Why is knowing that important?
 - No family history of glaucoma
 - Medical Hx: + Anxiety, uses Xanax prn
 - Goldmann IOPs OD= 26mmHg OD , OS=28mmHg 9:13 AM
 - PACHS 583um, 596 um
 - SLE: No K spindle, no PXF, 2+NS
 - Gonioscopy: Open to CB 360 degrees, 1-2+ pigment, No PAS




OD

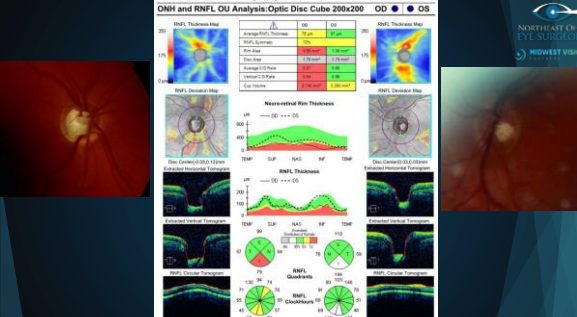
C/D is 0.75 with notch at 7:00
Bayonetting of ciliary artery at rim 7:30
Visible lamina/deep

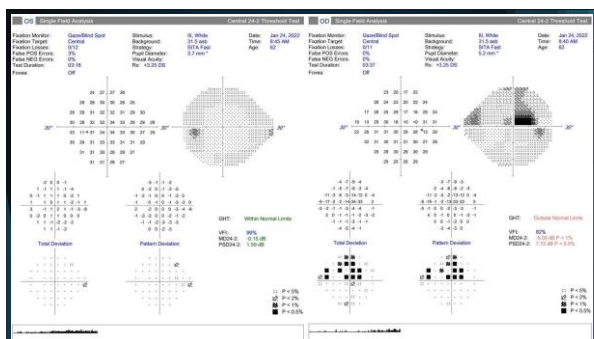


OS

C/D is 0.4 with possible slight inferior vertical elongation/notch /inf rim excavation
Asteroid Hyalosis







What is the diagnosis?

Diagnosis

OD: Severe/Advanced Glaucoma
 OS: Mild Glaucoma
 (or possibly just OHTN depending on how you interpret OCT and ONH appearance)

Classification of Glaucoma

Proper coding/staging:

- MILD:** ON findings consistent with glaucoma but NO VF abnormalities OR abnormalities present only on SWAP or FDT
- MODERATE:** ON findings consistent with glaucoma AND glaucomatous VF abnormalities in ONE hemifield and NOT within 5 degrees of fixation
- SEVERE:** ON abnormalities consistent with glaucoma AND glaucomatous visual field abnormalities in BOTH hemifields AND/OR loss within 5 degrees of fixation in at least one hemifield

IOP GOAL FOR THIS PATIENT

- What would you set as target IOP or range?
 - OD 26 mmHg
 - OS 28 mm Hg
 - Age 63
- EDM's Target Goal:
 - OD <14mm Hg
 - OS <18mm Hg

Diagnosing Glaucoma is Only The Beginning!

Lowering IOP is Only Proven Method to Treat Glaucoma

- Setting an IOP goal?
 - Based on the following:
 - Classification/Staging of glaucoma at time of diagnosis
 - Evidence Based Landmark Studies
 - AGIS
 - Those with unstable glaucoma were randomized to ALT or trabeculectomy
 - Eyes in which 100% of visits over a 4-year period had an IOP <18 mm Hg showed little VF progression
 - Those with IOPs 15 mm Hg showed half the progression of those with 18 mm Hg
 - Those with 13 mm Hg showed half the progression of 15 mm Hg

Setting an IOP Goal

Predicting Rate of Progression

- EMGT
 - Glaucoma progressed slower in the treated group but is variable
 - Every 1 mm Hg matters - For every 1 mm Hg reduction in IOP, risk of progression decreases by 10%
 - Follow progression closely and reset target IOP when progression confirmed
 - Pseudoexfoliation glaucoma doubled risk of VF loss

Setting an IOP goal

Other Important Considerations

- Age
- Race
- Life expectancy/general health
- Socioeconomic factors
- Living arrangements
- Ability to follow instructions
- Personal hygiene
- Status of other eye



Initiation of Treatment- First-line Options

- Pharmacologic Agent
 - Reach target IOP with fewest meds as possible
 - Reduce aqueous production from ciliary body (beta-blockers, carbonic anhydrase inhibitors, alpha-agonists)
 - Increase outflow via
 - Trabecular meshwork (cholinergic, nitric oxide donors, rho kinase inhibitors)
 - Uveoscleral pathway (prostaglandins)
- Surgical
 - SLT
- Intracameral Implant

Important to get patient buy in and input on treatment!

Treatment for this patient?

- What would you recommend to lower IOP?
- EDM treatment
 - Discussed all options
 - Patient elected meds 1st
 - Started 0.01% Bimatopost apm (after 5pm but before 10pm)
 - Recommended F/u in 1 month to see IOP reduction

After 1 month

- IOP reduced to
 - OD: 17mm HG
 - OS: 16mm HG

Are you happy with this?

With amount of damage OD and age of 63, IOP best at 14 or lower
Next steps?

- SLT
- 0.5% Timolol in AM OD only
- Change to Latanoprost/Netarsudil combo OU?

Next Steps:

- Patient elected SLT OD
- After 6 weeks post SLT IOP reduced to 12 mm Hg OD
- Recommend F/U in 4 months for IOP check
- VF/OCT testing ?
 - Annually to monitor for progression and establish rate of progression vs. repeating VF in 6 months to establish rate of progression is not fast?

Thoughts/debate on when to re-test?

Monitoring for Progression

- Once glaucoma diagnosis is made, clinician now shifts toward monitoring progression as well as estimating approximate rate of progression
- Functional VF loss negatively affects quality of life (mobility, reading, and driving) and goal as clinician is to reduce or avoid this devastating outcome
 - Rate of progression is individual and may take years to establish or could be rapid
 - Helpful to know if parent or sibling lost vision during their disease course; is this genetically aggressive or slower?

Progression

- Important to test VFs and OCTs frequently in early diagnosis to establish reliable baseline and rule out rapid progression

VF PROGRESSION

- Rates of MD change in most glaucoma patients vary from 0 to -2.5 dB/year, depending on the severity of disease, treatment, and population samples
- Rapid visual field progression is approximately -1.5 to -2 dB/year
- With intervention, most do not progress at a rate that would lead to functional impairment, but 3-17% of patients will continue to lose vision despite IOP optimum IOP lowering and progress to blindness within 20 years

Chauhan BC, Garway-Heath DF, Goni FJ, et al. Practical recommendations for measuring rates of visual field change in glaucoma. Br J Ophthalmol. 2008;92(4):569-573. doi:10.1136/bjo.2007.135012.108.
 Kirwan JF, Hustler A, Bobat H, Toms L, Crabb DP, McNaught A. Portsmouth visual field database: an audit of glaucoma progression. Eye. 2014;28(8):974-979. doi:10.1038/eye.2013.294.109.
 Saunders LJ, Medeiros RA, Weinreb RN, Zangwill LM. Worst rates of glaucoma progression are clinically significant?. Expert Rev Ophthalmol. 2016;11(3):227-234. doi:10.1080/17469899.2016.1180246

Progression

OCT Progression

- Difference of $\geq 7 \mu\text{m}$ thinning in superior and inferior quadrants between scans
- Difference of $\geq 4-5 \mu\text{m}$ thinning for average RNFL difference between scans
- Typical RNFL progression patterns
 - Widening of existing RNFL defect
 - Deepening of current RNFL defect
 - Development of a new RNFL defect – Inferior temporal location most common site of progression
- Evaluating progression in advanced glaucoma is best using serial VFs since retinal thinning bottoms out (floor effect)
- Once thinning hits floor, progression can still occur but OCT can't detect it
- Use macular OCT and HVF 10-2 to monitor progression in advanced glaucoma

Mwanza JC, Chang RT, Budenz DL, et al. Reproducibility of peripapillary retinal nerve fiber layer thickness and optic nerve head parameters measured with Cirrus HD-OCT in glaucomatous eyes. Invest Ophthalmol Vis Sci. 2010;51(11):5724-5730.
 Leung CK, Yu M, Weinreb RN, et al. Retinal nerve fiber layer imaging with spectral-domain optical coherence tomography: patterns of retinal nerve fiber layer progression. Ophthalmology. 2012;119:1826-1844.

Guidelines for Testing for Progression

Visual Fields

- European Glaucoma Society guidelines: VF testing three times per year in the first 2 years after initial glaucoma diagnosis
- Need to obtain enough VFs initially to get reliability and repeatability
 - Minimum every 12 months if reliable and rate of progression deemed slower
 - More frequent if high risk or progression identified
 - Perform 10-2 from time to time to look for macular defects not seen on 24-2

Imaging

- Repeat every 6-12 months depending on if mild to moderate
- Evaluate both macular and ON tomography
- ON imaging may not be beneficial for advanced disease due to "floor effect"

Muckley's Treatment Algorithm and Management Plan After POAG Diagnosis

Assess risk factors and set target IOP based on progression risk factors, life expectancy to age 100 years, amount of nerve and visual field damage, and initial T_{max}.
 Keep in mind setting target IOPs are "best guesses" and may need re-evaluated as changes occur

POAG defined as T_{max} > 23mm HG with evidence of glaucomatous damage on OCT, VF, or in ONH

- Mild glaucoma, aim for target IOP <18 mm Hg at all time points
- Moderate glaucoma, aim for IOP <15 mm Hg at all time points
- Advanced glaucoma at time of diagnosis, aim for IOP <12mmHg

TREATED OHTN defined as T_{max} > 23mm HG with no evidence of glaucomatous damage on OCT, VF, or in ONH but high risk factors for developing glaucomatous optic neuropathy that you recommend intervention. I recommend treating OHTN over 27mm Hg to my patients and discuss risks/benefits ratio so they are included in the decision to initiate prophylactic treatment.

- Aim for target IOP ± 21 mm Hg at all time points

Monocular trials

- Not clinically efficient or helpful in determining effectiveness as IOP fluctuation is asymmetric
- Initiate therapy simultaneously in both eyes if indicated

LTG defined as T_{max} \leq 22mm HG with evidence of glaucomatous damage on OCT, VF, or in ONH

- Mild- aim for target IOP 20-30% lower than baseline T_{max} at all time points
- Moderate- aim for 30-50% lower than baseline T_{max} at all time points
- Advanced at time of diagnosis, aim for IOP in single digits

Muckley's Treatment Algorithm and Management Plan After POAG Diagnosis

Choosing therapy
 Educate patient on first line treatments- topical meds vs SLT and let them help decide based on compliance, cost, and understanding of disease

MEDICATION

- Review systemic conditions, current medications, and allergies before prescribing
- Start with prostaglandin analog and recheck IOP 4wks. later

If IOP still not at target consider any of the following:

- Switching within prostaglandin class iflatanoprost chosen as first agent due to cost/insurance to keep on single agent if only a small amount of additional IOP lowering needed
- Change to Nocolatan™ to keep on single agent (better compliance and ocular surface protection)
- Add topical beta-blocker in AM only as second agent to minimize ocular surface issues- does not lower nocturnal IOP as well so also should consider topical CA II.i.d. as adjunct therapy
- Reductasis SLT
- Consider topical alpha agonist or CAII adjust 2nd or 3rd line, especially if unable to take beta-blocker
- Utilize combination agents to preserve ocular surface and facilitate compliance

SELECTIVE LASER TRABECULOPLASTY

- Education on risks, benefits, effectiveness, and possible need for future topical meds
- Refer or perform SLT if scope allows
- Follow post-op as outlined in section Treatment and Management I.B.3.a.

Muckley's Treatment Algorithm and Management Plan After POAG Diagnosis

Follow Up

<p>Treated OHTN (No ON or VF damage)</p> <ul style="list-style-type: none"> • Every 6 months alternate between IOP/undilated disc check (look for disc heme every visit) and dilated complete exam with VF/OCT/gonioscopy testing annually 	<p>Mild</p> <ul style="list-style-type: none"> • Every 6 months alternate between IOP/undilated disc check and dilated complete exam with VF/OCT/gonioscopy testing • Add in 10-2 if one to two central points missed on 24-2 	<p>Moderate</p> <ul style="list-style-type: none"> • IOP checks every 4 months at different time points • May need VF or OCT testing 1-2x a year based on risks • Add in 10-2 if central points missed on 24-2 • ON funduscopy at each visit with annual dilation and gonioscopy minimum 	<p>Advanced</p> <ul style="list-style-type: none"> • IOP checks every 3 months at different time points with funduscopy (dilation minimum 2x a year) • Annual gonioscopy • VF testing 2x a year minimum (up to 4VFs a year; may need 10-2) • Limited usefulness of imaging/photography
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Muckley's Treatment Algorithm and Management Plan After POAG Diagnosis

If progression noted on testing despite maintaining IOP goal

- ✓ Lower IOP further another 3-4 points
- ✓ Increase follow up visits and testing to re-establish rate of progression and adjust if demonstrates stability in VF/OCT/ON testing
- ✓ Consider MIGS intervention earlier and especially if cataracts are visually significant

Education at each visit



- ✓ Patients need to understand we cannot cure or reverse glaucoma
- ✓ Despite our best efforts in IOP reduction, progression can still occur
- ✓ Show patient their VF, OCT, and disc photos- explain what you are evaluating
- ✓ Goal is to prevent functional decline and decreased quality of life
- ✓ Re-education on compliance and adherence to therapy

It's a Snap!

Case 2

Background

- 21 year old black, male, Kent State football athlete was hit in the R eye by a snapped exercise band during a work-out earlier today. Pt had pain, swelling of eyelid, and blurred vision
- Vision 20/200 OD, 20/20 OS, Pupil showed poor reactivity OD,

What is the first thing you must rule out?

Open/ Ruptured Globe

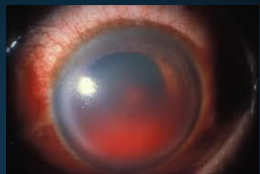
4+ severe, bullous SCH 360, scleral laceration, peaked pupil, limitation of EOMs

Biomicroscopy

- 1+ Lid edema and starting ecchymosis
- +SCH
 - No ruptured globe
- 1+descemet's folds
- Iris intact- no iridodialysis
- 3-4+ RBCs in A/C not yet layered
- Lens in place
- IOP 32 OD, 15 OS

DO YOU DILATE PATIENTS WITH HYPHEMA?
DO YOU GONIO PATIENTS WITH A HYPHEMA?

- Please dilate!
- Gonio delayed until after the critical 5-day, high-risk, re-bleed period unless IOP increases over time- no compression/3mirror



NORTH EAST OHIO
EYE SURGEONS
MIDWEST VISION

- Fundus
 - Poor view of retina due to media, no obvious detachment or commotio, good red reflex

What is our official diagnosis?


NORTH EAST OHIO
EYE SURGEONS
MIDWEST VISION

- Diagnosis
 - Traumatic Hyphema
 - Secondary Acute Glaucoma

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Hyphema etiology

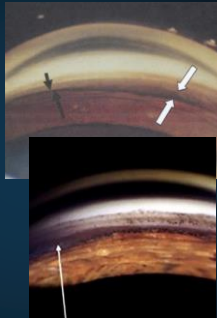
- Iris sphincter tears are relatively common following blunt ocular trauma
- Vast majority of hyphemas are the result of a tear in the face of the ciliary body
 - Consequent bleeding from the major arterial circle of the iris or other arterial or venous branches supplying the ciliary body
- High risk of angle recession



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Angle Recession

- Most individuals developing glaucoma in the setting of ocular trauma with angle recession have at least 180° of angle involvement
 - The degree of recession does correlate with the development of glaucoma
- Patients need gonioscopy 4 weeks after trauma



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EYE SURGEONS
MIDWEST VISION

How do we treat or manage this patient?

Any special considerations?

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Special Considerations



- 1) Is patient on any other meds that thin blood?
 - NSAIDs, Coumadin, etc.
- 2) Critical to note in Black or Mediterranean patients to ask about sickle cell trait and disease

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Why is sickle cell a concern?


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- RBCs can sickle in AC
- Sickled red blood cells clog TM
- As IOP rises, further hypoxia occurs, increasing sickling
- Central retinal artery can be more under stress at lower IOPs (24mmHG)
 - Increased risk of CRAO and AION quickly at IOPs that most would tolerate otherwise
- Occurs with all phenotypes
 - Sickle trait<sickle disease<sickle anemia

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EYE SURGEONS
MIDWEST VISION

- Only since 2006, have all states required and provided universal newborn screening for SCD
- If IOP elevated with hyphema, order:
 - Sickle cell prep: Screener for sickle cell
 - If prep comes back positive, order Hemoglobin electrophoresis: Diagnostic in determining sickle cell trait or disease
- May take time to get results so proceed keeping possibility in mind
 - Approximately 10% carry the Hbs gene



Condition	Clinical features	Hb level g%	MCV f	Hb electrophoresis
Sickle cell trait	None, rare painless hematuria	normal	normal	HbS:A: 49:51
Sickle cell anemia	Vasocclusive crises, AVN, gall stones, priapism	7-10	85-100	HbS:A:100:0 HbF:2-25%
S beta0 thalassemia	Vasocclusive Crises, AVN	7-10	60-80	HbS:A:100:0 HbF:1-10%
S beta+ thalassemia	Rare crises, AVN	10-14	70-80	HbS:A: 50:50
HbSC	+Sb- reticulopathy	10-14	80-100	HbS:A:50:0 HbC:50%

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EYE SURGEONS
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- I ordered sickle screening
 - Did come back negative
- Topical Therapy
 - Cycloplegic
 - Atropine qd
 - Steroid
 - q 2hrs initially
 - Glaucoma Drops
 - Which ones would you not choose?

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EYE SURGEONS
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Glaucoma Meds

- Best choice is beta blocker and alpha agonists
 - Avoid prostaglandin as it can increase inflammation
- Avoid oral and topical carbonic anhydrase inhibitors in patients with sickle cell trait or disease
 - Can increase sickling of erythrocytes
 - Alters aqueous pH → acidosis → promotes sickling
 - Methazolamide may be a better choice in this situation (Neptazane 50 mg PO q8h).

I started combo brimonidine/timolol b.i.d.

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EYE SURGEONS
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Treatment

- Oral steroids is controversial
 - Despite antifibrinolytic properties, no clear benefit in resolution of hemorrhage or preventing rebleeding
- If topical and oral therapy fail, then surgical evacuation of blood necessary
 - Also necessary if corneal blood staining and hyphema not layering
 - If hyphema not < 50% by day 8
 - If IOP >60 for > 48 hours
 - If +sickle cell trait, and IOP spikes > 30

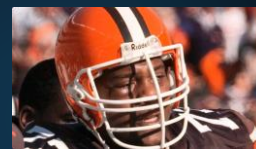
Treatment

- Supportive treatment
 - Eye shield at all times (during the day and at night)
 - Strict bed rest has not been shown to be beneficial in comparison to mild activity
- Head elevation (up to 30°) helps level the blood inferiorly and keeps the central cornea and pupil aperture unobstructed
- Aspirin/NSAIDs should be avoided to prevent rebleeding



Going Home Instructions

- Atropine q.d.
- Steroid q2hrs.
- Brimonidine/timolol b.i.d.
- Eye Shield
- Bed Rest
- Sleep Propped Up
- RD Warnings Given
- Education on future risk of Glaucoma if angle recession present
 - Gonio in a few weeks
- Lab Orders for Sickle Prep Screen **Stat**



Late Orlando Brown



Next Day

- Hyphema layering 25%
- Less injection, K edema
- IOP 24mmHg
- Sickle Prep Negative




Weeks to come

- Continue to monitor every few days until hyphema resolves
- Adjust meds as condition improves
 - Taper Durezol- rebound iritis
- Re-examine fundus as soon as you get visibility of retina
- Gonio at 4-6 weeks to look for angle recession
 - If present, get baseline OCT and VF
 - Monitor every 6 months for change over time
 - Significant education on angle recession critical

Case 3

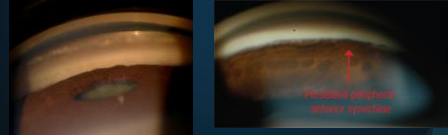

- 73 yr old white female reports on a Saturday AM for a complete eye exam because the vision in right eye has been blurry since she had covid 4 months ago
- Complains of a dull ache behind the eye possibly 2x/week, does not last very long
- Pt denies new floaters but notes they've been having some flashes like looking at stars
- Medical History:
 - Thyroid Disease, HTN, HOH, Arthritis
- Systemic Meds:
 - Levothyroxine, Losartan

- VA OD: Dcc20/50-1. Pinhole20/30-2.
OS: Dcc20/30+2
- Present Glasses: OD +2.25 +1.00 006 +3.00
OS +2.00 +1.00 009 +3.00
- Pupils: OD: Minimal reaction 5mm fixed
OS: 2+ reactivity 3mm Round
- IOP: App OD: 61,62 OS: 19,21



<p>OD Cornea: 1+ ABMD A/C: Shallow and Quiet Iris Normal Appearing Lens: 1-2+ NS.</p>	<p>OS Cornea: tr ABMD A/C: Shallow and Quiet Iris: Normal Appearing Lens: 1-2+ NS</p>
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Gonioscopy: OD SL 360 no structures seen with evidence PAS on indentation
OS TM inferior with SL nasal, temporal, and superior

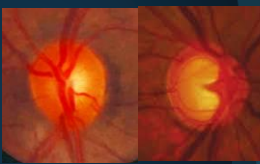

Undilated

Disc: OD: CDR 0.7-75, thin inferior rim
OS: CDR 0.5 normal rim

Vitreous: PVD OD


Retinal Vessels: Normal OU

Macula: No Subretinal Fluid, Hemorrhage or Exudate OU

Diagnosis

- Chronic Angle Closure Glaucoma Indeterminant OD
- Angle Closure OS



Correct Terminology

Angle-closure suspect/ Narrow angle


- Less than TM seen in 2 quadrants
- No PAS
- No glaucomatous cupping or VF defect

Angle closure


- Above findings with evidence of PAS

Angle closure glaucoma

- Above findings plus glaucomatous atrophy and/or VF defects




PAS - Peripheral Anterior Synechiae



What do you do next?

- Panic?
- Refer for LPI?
- Order VF/OCT?
 - Remember this has been going on for awhile- months even
 - First try to pharmacologically break the attack and lower IOP
 - Helps make the PI easier to perform
 - LPI does not have to happen stat right then- can wait until Monday
 - You do need to protect the other eye as well



NORTHEAST OHIO EYE SURGEONS
MIDWEST VISION

- Start beta blocker, alpha agonist, pilocarpine and topical CAI spacing drops about 10 mins apart
 - Can give prostaglandin but may not be as effective over IOP 55mmHG
- Also add topical Prednisone for inflammation
- Give two 250mg tablets of oral Acetazolamide in office
- Check IOP in 40 minutes
- Send patient home with all topical drops plus 500mg oral CAI
 - Put patient on 1% Piloqid for OS tp prevent AAC attack until LPI performed
- Schedule patient for Monday AM LPI OU unless you are in a state where you can perform the LPI right then

NORTHEAST OHIO EYE SURGEONS
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LPI was successfully performed Monday AM OU- now what?

- Measure IOP next day- patient was still on combo topical beta blocker and alpha agonist plus prostaglandin
 - IOP was 11 OD and 13 OS next day
- Stage the glaucoma and evaluate damage and need for further treatment
 - Recheck gonio and LPI patency at 3-4 weeks

NORTHEAST OHIO EYE SURGEONS
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ONH and RNFL OU Analysis Optic Disc 200x200 OD OS

ONH and RNFL Analysis for OD and OS. Metrics include RMI, RMI Variance, RMI Variance Ratio, and RMI Variance Ratio. The analysis shows significant damage in the OD and OS.

NORTHEAST OHIO EYE SURGEONS
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Central Visual Field Analysis

Central Visual Field Analysis for OD and OS. The analysis shows significant visual field defects in both eyes, consistent with angle closure glaucoma.

NORTHEAST OHIO EYE SURGEONS
MIDWEST VISION

Diagnosis?

- OD: Severe Angle Closure Glaucoma
- OS: Angle Closure

Next Steps?

NORTHEAST OHIO EYE SURGEONS
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- With amount of damage OD IOP goal set to < 14mmHg, OS goal <22mmHg
- Patient to stay on combo brimonidine/timolol bid OD
- Can trial stopping prostaglandin OD
- No topical meds needed OS

Will monitor patient every 4-6 months

What about clear lens extraction?

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