The Pressure is On:
Managing Challenging Cases in Glaucoma

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Mark Dunbar OD: Financial Disclosure

- Optometry Consultant
  - Carl Zeiss
  - Allergan
  - Regeneration
  - Genentech
- Advisory Board for:
  - Allergan
  - Carl Zeiss
  - Regeneron
  - Genentech

Mark Dunbar does not own stock in any of the above companies

2

Full Disclosure

- Nothing I say in this lecture will have been an original thought
- I have shamelessly copied and pillaged almost every thought or concept discussed in this talk

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General Principles in Glaucoma Management

- The **higher the IOP**, the **greater the risk** of acquiring glaucomatous damage and the greater the risk for progression
- There are **factors other then IOP** that contribute to ON damage and determine an individual susceptibility to harm from IOP
- At the moment, there is no effective treatment for glaucoma other then lowering IOP

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What other factors besides IOP contribute to glaucomatous ON damage?

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80 yo White Female

- Presented for "annual eye exam"

HPI

80 yrs old, female New Patient here for annual check
Feels vision at distance was not as good as it has been, especially the LE

She uses glasses to see small prints, reports good vision at distance OU.
Denies pain, floaters or flashes of light.
S/p: CEIOL OU, YAG laser posterior capsulotomy OD (Baptist Hospital)
LEE: 02/2017 by M.D (w/DFE)

Mom had glaucoma and used drops

Generally does not wear glasses for driving

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80 yo White Female

Oct 2017

Base Eye Exam

Visual Acuity (Snellen - Linear)

	Right	Left
Dist sc	20/30 -1	20/30 -1
Dist ph sc	20/30+2	NI
Near sc	J3	J2
Near cc	J1+	J1+

Correction: Glasses

Tonometry (Tonopen, 10:00 AM)

	Right	Left
Pressure	15	15

Pupils

Pupils equally round reactive to light
No APD

Visual Fields (Counting fingers)

	Left	Right
Result	Full	Full

Extraocular Movement

	Right	Left
Result	Full, Ortho	Full, Ortho

Neuro/Psych

Oriented x3: Yes
Mood/Affect: Normal

Refraction

Wearing Rx

	Sphere	Cylinder
Right	+3.00	Sphere
Left	+3.00	Sphere

Type: SVL(near)

Manifest Refraction

	Sphere	Cylinder	Dist	Add	Near
Right	+0.00	+0.00	20/30-1	+3.00	20/20
Left	+0.00	+0.00	20/30-1	+3.00	20/20

Cycloplegic Refraction

	Sphere	Cylinder	Axis	Dist	Add
Right	-1.00	+0.75	104	20/20	+2.75
Left	-1.00	+0.50	119	20/20	+2.75

Final Rx

	Sphere	Cylinder	Axis	Add
Right	-1.00	+0.75	104	+2.75
Left	-1.00	+0.50	119	+2.75

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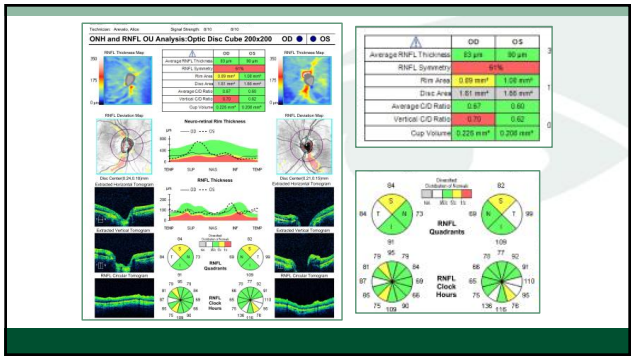

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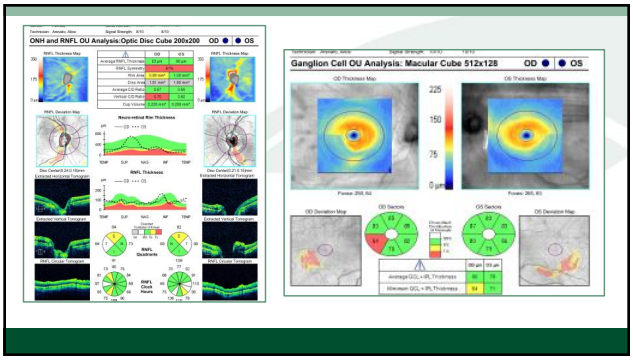

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So now what?

Is this low/normal tension glaucoma?

Would you begin treatment today?

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Would you begin treating <u>on this visit</u>?

1. Yes
2. No
3. I would refer to ophthalmologist

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This is what I did…

Impression
1) Probable Normal Tension Glaucoma OU
   Inferior thinning OU
   Disc hemorrhage RE inferior
   OCT and GCC thin corresponding to clinical presentation
   TA ~ 15 OU
2) Pseudophakia OU
3) PVD OU

Plan
1) Ed and reassure
2) RTC 1-2 weeks for VF and IOP measurement
3) Will start Tx at next visit
4) Rx given for specs

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A Few Thoughts on Disc Heme

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In the OHTS Study what percentage of disc hemorrhages were MISSED by the doctor?

1. 24%
2. 44%
3. 64%
4. 84%

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Detection and Prognostic Significance of Optic Disc Hemorrhages during the Ocular Hypertension Treatment Study

Donald L. Budenz, MD, MPH,[1] Douglas R. Anderson, MD,[1] William J. Feuer, MS,[1] Julia A. Beiser, MS,[2] Joyce Schiffman, MS,[2] Richard K. Parrish II, MD,[1] Jody R. Piltz-Seymour, MD,[3] Mae O. Gordon, PhD,[2] Michael A. Kass, MD,[2] Ocular Hypertension Treatment Study Group

- Disc hemorrhages detected in 128 eyes of 123 participants
- 21 cases detected by both doctor and photos
- **107 cases (84%) were detected only by a review of photography**

Ophthalmology Dec 2006

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Perhaps the Bigger Question?

- How is it that a patient can continue to "progress" or develop a disc hemorrhage with a pressure ~ 12?
- What are the factors that result in progression?

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What other factors besides IOP contribute to glaucomatous ON damage?

- Blood pressure
  - – High vs Low blood pressure (BP)
- Reduced ocular blood flow
  - – Lower ocular perfusion pressure (OPP0
- Intracranial pressure (ICP)

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Ischemia vs. Mechanical

- **Ischemia:** elevated IOP reduces blood flow to the optic nerve, thus creating chronic ischemia within the neural tissue
  - Local ischemia-hypoxia develops ? dysfunction of blood flow autoregulation
- **Mechanical**: damage due to the mechanical affects of the elevated IOP
  - "Pressure" on the ON/Lamina
  - Ganglion cell axons undergo **deformation** and **mechanical** stress

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Where Does Blood Pressure Fit In?

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Where Does Blood Pressure Fit In?

- 1990's: Hayreh, Drance, and others 1st raised the important issues of **systemic hypotension** and **nocturnal blood pressure dips** in the progression of glaucoma
- The problem: difficult to measure systemic BP during sleeping hours

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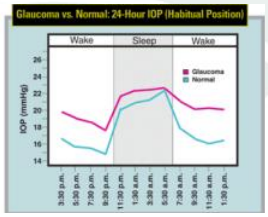
When is the highest IOP during the 24-hour cycle?

- IOP is a dynamic physiological parameter that doesn't remain constant over the course of 24 hours
- Trough IOP levels tend to occur at the end of the waking period
- Peak IOP is usually recorded at the end of the nocturnal sleep period



Liu JH, Kripke DF, Twa MD, et al. Twenty-four hour pattern of intraocular pressure in the aging population. Invest Ophthalmol Vis Sci 1999;40:2912-2917.

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Risk Factors For Progression

- **BP is lowest** at night
- **IOP is highest** during the night time
  - Highest prior to waking
- Combination of ↑ IOP and ↓ BP may result in a critical ↓ ocular perfusion pressure (OPP) in susceptible people
  - Patients with with faulty autoregulation

Mosaed S, Liu JH, Weinreb RN. Correlation between office and peak nocturnal intraocular pressures in healthy subjects and glaucoma patients. Am J Ophthalmol 2005;139:320-4.

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Ocular Perfusion Pressure (OPP)

- **OPP is the relative pressure at which blood enters the eye**
- Defined as the ocular arterial pressure minus the IOP
- OPP is a delicate balance between **IOP** and **blood pressure**
- Low ophthalmic perfusion pressure (OPP) is a risk factor for progression
  - Low BP and/or high IOP

MOPP = 2/3 X [DBP + 1/3 X (SBP – DBP)] – IOP
Simple: Diastolic BP – IOP = OPP

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Low OPP and Glaucoma

Epidemiologic Studies Linking Diastolic Perfusion Pressure and Glaucoma

Study	Design	Participants	Glaucoma Risk From Low DPP vs Normal DPP
Baltimore Eye Survey[1]	Cross-sectional	Non-Hispanic Whites and African Americans	6-fold
Egna-Neumarkt Study[2]	Cross-sectional	Non-Hispanic Whites	2.5-fold*
Proyecto VER[3]	Cross-sectional	Hispanics	4-fold
Los Angeles Latino Eye Study[4]	Cross-sectional	Hispanics	1.9-fold
Barbados Eye Study[5]	Longitudinal	Afro-Caribbeans	3.2-fold (4 years)

1. Tielsch JM, et al. *Arch Ophthalmol*. 1995;113(2):216-221. 2. Bonomi L, et al. *Ophthalmology*. 2000;107(7):1287-1293. 3. Quigley HA, et al. *Arch Ophthalmol*. 2001;119(12):1819-1826. 4. Memarzadeh F, et al. *Invest Ophthalmol Vis Sci*. 2010;51(6):2973-2977. 5. Leske MC, et al. *Arch Ophthalmol*. 2002;120(7):954-959.

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Low OPP and Glaucoma

Table 1 Low diastolic ocular perfusion pressure and prevalence of open-angle glaucoma

Study	*n*	Diastolic OPP <50–55 mmHg
Baltimore Eye Survey	5308	↑ Prevalence: 2–6-fold
Egna-Neumarkt Study	4297	↑ Prevalence: 3-fold only in high-tension glaucoma[a]
Proyecto VER	4774	↑ Prevalence: 4-fold
Barbados Eye Study	4631	↑ Prevalence: >3-fold
Rotterdam Eye Study (only participants receiving treatment for systemic hypertension)	1329	↑ Prevalence: >4-fold only in high-tension glaucoma (mainly probable glaucoma)

Adapted from [10–13,14••]. OPP, ocular perfusion pressure.
[a]Low OPP was defined as <68 mmHg in this study.

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Risk Factors for Visual Field Progression in the Low-pressure Glaucoma Treatment Study

CARLOS GUSTAVO DE MORAES, JEFFREY M. LIEBMANN, DAVID S. GREENFIELD, STUART K. GARDINER, ROBERT RITCH, AND THEODORE KRUPIN, ON BEHALF OF THE LOW-PRESSURE GLAUCOMA TREATMENT STUDY GROUP

We determined that a lower MOPP during follow-up was significantly associated with visual field progression in our model and this effect was not significantly affected by other covariates, such as use of systemic antihypertensives and randomization arm (Table 4). An imbalance between

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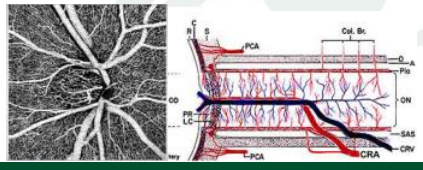
Vascular Supply to the ON

- COMPLEX arterial supply and an even more complex venous drainage system
- Which vascular network is most critical for development of glaucoma?



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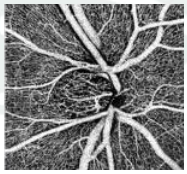
OPP and Glaucoma – The Reality

- Perfusion pressure is **difficult to accurately measure**
- There is currently **no widely accepted consensus** regarding **which techniques** should be used to evaluate blood flow or how the results should be interpreted
- None of the methods used to estimate blood flow have been standardized or externally validated for humans
- Ocular blood flow measurements are not currently used in the diagnosis or management of patients with glaucoma



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CSFp and Glaucoma

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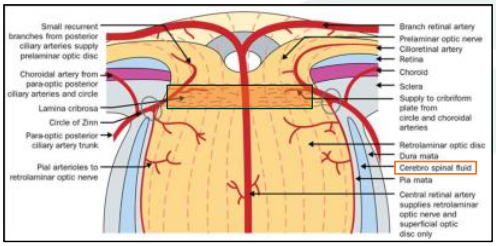

CSF (ICP) causes more displacement of the lamina then IOP

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2008

Cerebrospinal Fluid Pressure Is Decreased in Primary Open-angle Glaucoma

John P. Berdahl, MD,[1] R. Rand Allingham, MD,[1] Douglas H. Johnson, MD[2,3]

Purpose: To compare cerebrospinal fluid (CSF) pressure in patients with primary open-angle glaucoma (POAG) with that in nonglaucomatous patients.
Design: Case–control study.
Participants: Thirty-one thousand, seven hundred and eighty-six subjects underwent lumbar puncture (LP) between 1996 and 2007 at the Mayo Clinic, Rochester, Minnesota. Of these, 28 patients who had POAG and 49 patients who did not have POAG were analyzed.
Methods: Retrospective review of medical records. Comparison of the 2 groups and factors associated with CSF pressure were analyzed by univariate and multivariate analyses.
Main Outcome Measures: Demographics (age and gender), medical history, medication use, indication for LP, intraocular pressure (IOP), optic disc cup-to-disc ratio, visual field assessment, and CSF pressure.
Results: The mean CSF pressure ± standard deviation was 13.0±4.2 mmHg in nonglaucoma patients and 9.2±2.9 mmHg in POAG patients ($P<0.00005$). The CSF pressure was lower in POAG patients regardless of indication for LP or age. Linear regression analysis showed that cup-to-disc ratio correlated independently with IOP ($P<0.0001$), CSF pressure ($P<0.0001$), and the translaminar pressure difference ($P<0.0001$). Multivariate analysis demonstrated that larger cup-to-disc ratio ($P<0.0001$) was associated with lower CSF pressure.
Conclusions: Cerebrospinal fluid pressure is significantly lower in POAG patients compared with that in non-glaucomatous controls. These data support the notion that CSF pressure may play an important contributory role in the pathogenesis of POAG. *Ophthalmology 2008;115:763–768 © 2008 by the American Academy of Ophthalmology.*

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Mayo Clinic Study: CSF and Glaucoma

- Retrospective review of 31,786 patients that had lumbar punctures over a 11-year period
- Determined # who had complete eye exams
- 28 met inclusion criteria of POAG, 49 controls
- **ICP was significantly lower** in patients with POAG compared to the non-glaucoma control

Berdahl JP, et al. *Ophthalmology*. 2008;115(5):763-768.

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Berdahl 2nd Mayo Clinic Study: CSF and Glaucoma
POAG vs. NTG vs OHT

- Retrospective review of 62,468 patients that had lumbar punctures over a 20-year period
- 189 met inclusion criteria of complete eye exam
- **ICP** was significantly **lower** in patients with POAG and NTG and **significantly higher in OHT**

Berdahl JP, Fautsch MP, Stinnett SS, et al Intracranial pressure in primary open angle glaucoma, normal tension glaucoma, and ocular hypertension: a case-control study. Invest Ophthalmol Vis Sci. 2008;49(12):5412-5418

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Cerebrospinal Fluid Pressure in Glaucoma
A Prospective Study

Ruojin Ren, MD,[1,2] Jost B. Jonas, MD,[1,4] Guoglong Tian, MD,[3] Yi Zhen, MD,[2] Ke Ma, MD,[1] Shuning Li, MD,[2] Hongyan Wang, MD,[2] Bin Li, MD,[3] Xiaojun Zhang, MD,[1] Ningli Wang, MD[2]

Purpose: To assess whether a low cerebrospinal fluid pressure (CSF-P) is associated with open-angle glaucoma in eyes with normal intraocular pressure (IOP).
Design: Prospective, interventional study.
Participants: The study included 43 patients with open-angle glaucoma (14 with a normal IOP, and 29 with an elevated IOP) and 71 subjects without glaucoma.
Interventions: All patients underwent standardized ophthalmologic and neurologic examinations and measurement of lumbar CSF-P.
Main Outcome Measures: Cerebrospinal fluid pressure and IOP.
Results: Lumbar CSF-P was significantly ($P<0.001$) lower in the normal IOP glaucoma group (9.5±2.2 mmHg) than in the high IOP glaucoma group (11.7±2.7 mmHg) or the control group (12.9±1.9 mmHg). The trans-lamina cribrosa pressure difference [IOP minus CSF-P] was significantly ($P<0.001$) higher in the normal IOP glaucoma group (6.6±3.6 mmHg) and the high-IOP glaucoma group (12.5±4.1 mmHg) than in the control group (1.4±1.7 mmHg). The extent of glaucomatous visual field loss was negatively correlated with the height of the CSF-P and positively correlated with the trans-lamina cribrosa pressure difference. In the control group, CSF-P was significantly correlated with both systolic blood pressure ($P = 0.04$) and IOP ($P<0.001$). The trans-lamina cribrosa pressure difference was not significantly associated with blood pressure ($P = 0.97$).
Conclusions: In open-angle glaucoma with normal IOP, CSF-P is abnormally low, leading to an abnormally high trans-lamina cribrosa pressure difference. Pathogenetically, a low CSF-P in normal-IOP glaucoma may be similar to a high IOP in high-IOP glaucoma. Consequently, the glaucomatous visual field defect is positively correlated with the trans-lamina cribrosa pressure difference and inversely correlated with the CSF-P. In nonglaucomatous subjects, CSF-P, blood pressure, and IOP are significantly associated with each other.
Financial Disclosure(s): The authors have no proprietary or commercial interest in any of the materials discussed in this article. *Ophthalmology 2010;117:259–266 © 2010 by the American Academy of Ophthalmology.*

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Lumbar CSF Pressure in NTG, POAG and Non GL

Ophthalmology *Volume 117, Number 2, February 2010*

Table 3. Measurements of Lumbar Cerebrospinal Fluid Pressure in Patients with Normal-Pressure Glaucoma, High-Pressure Glaucoma, and Nonglaucomatous Subjects

	Normal-Pressure Glaucoma Group	P-Value	High-Pressure Glaucoma Group	P-Value	Control Group
N	14		29		71
Cerebrospinal fluid pressure (mmHg)	9.5±2.2	0.013	11.7±2.7	<0.001	12.9±1.9
Median	10.1		12.1		12.9
Range	3.7–12.9		6.6–19.1		7.0–16.9

P value: Statistical significance of the difference between the group in the preceding column and the group in the next column (Mann-Whitney U test).
The difference in cerebrospinal fluid pressure was statistically significant ($P<0.001$) also for the comparison between the normal-pressure glaucoma group and the control group.

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Trans-Lamina Cribrosa Pressure Difference

Table 4. Measurements of the Trans-Lamina Cribrosa Pressure Difference (Intraoperative Pressure Minus Cerebrospinal Fluid Pressure) in Patients with Normal-Pressure Glaucoma, High-Pressure Glaucoma and Nonglaucomatous Subjects

	Control Group	P-Value	Normal-Pressure Glaucoma Group	P-Value	High-Pressure Glaucoma Group
N	71		14		29
Trans-lamina cribrosa Pressure difference (mmHg)	1.4±1.7	<0.001	6.6±3.6	<0.001	12.3±4.1
Median	1.6		6.0		11.9
Range	−3.6 to 4.5		1.6–13.3		6.6–24.9
Trans-lamina cribrosa Pressure difference (mmHg) (highest recorded values)	3.0±1.6	<0.001	9.0±2.8	<0.001	16.8±4.8
Median	2.8		8.4		15.3
Range	−1.2 to 6.9		4.1–15.3		8.9–27.9

P value: Statistical significance of the difference between the group in the preceding column and the group in the next column (Mann-Whitney *U* test).
The difference in the trans-lamina cribrosa pressure difference was statistically significant (P<0.001) also for the comparison between the high-pressure glaucoma group and the control group.

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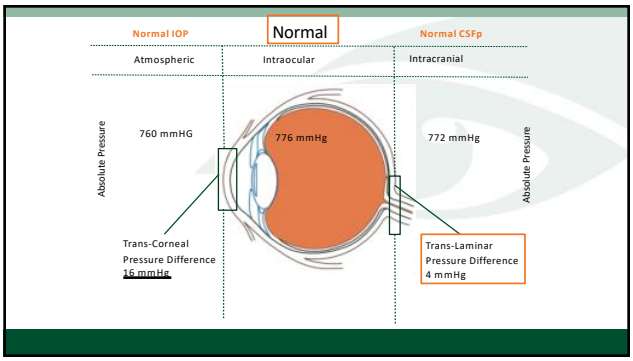

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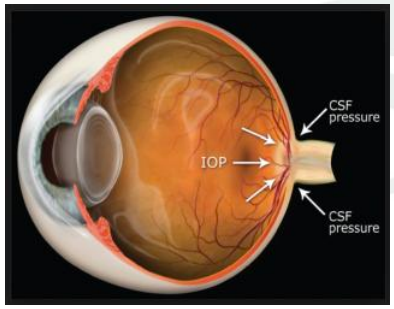

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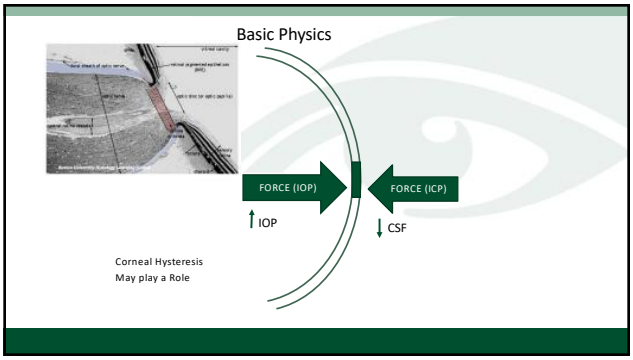

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Relationship between IOP and CSF

- In the normal state IOP and CSF have **minimal trans-laminar pressure differences**
- Increasing the difference **alters the homeostatic balance** and results pressure gradient difference at the lamina

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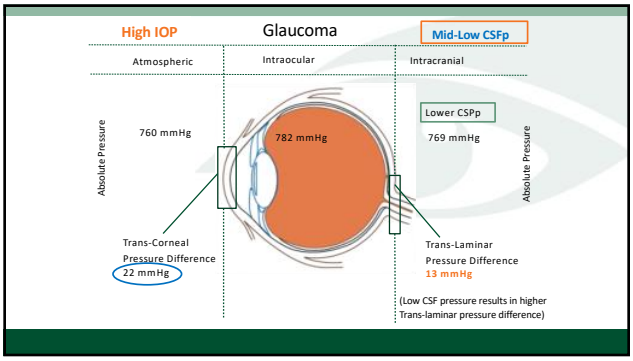

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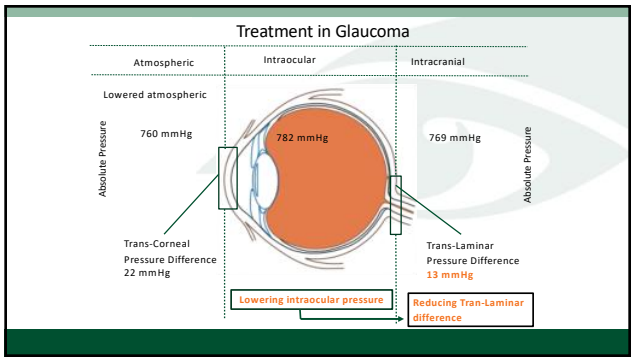

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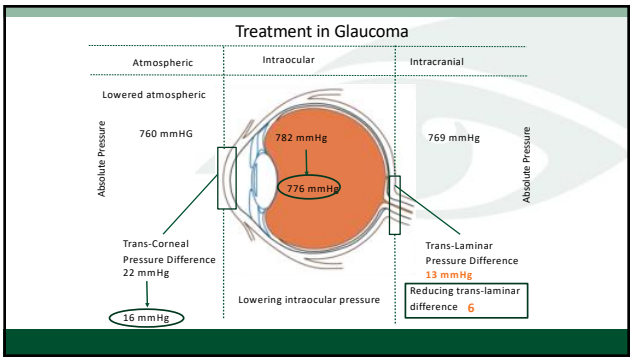

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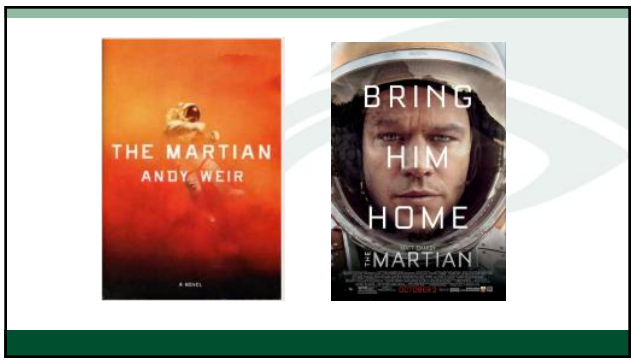

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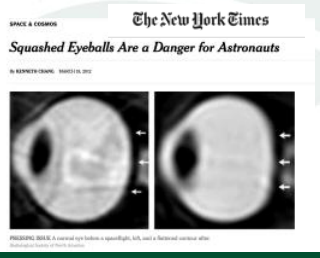
60% of astronauts suffer ocular problems related to prolonged space travel

- Globe flattening
- Hyperopic shift
- Choroidal folds
- Disc swelling



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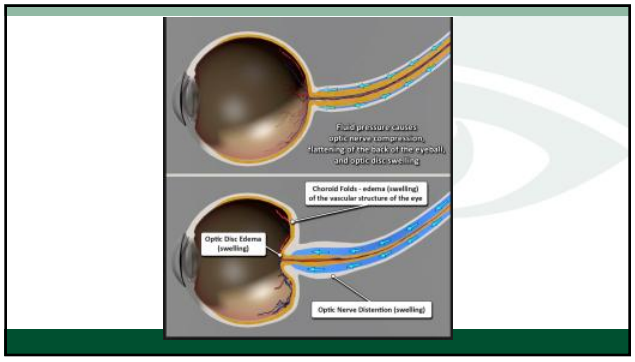

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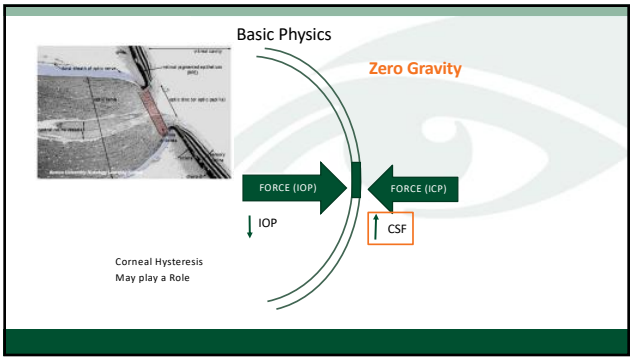

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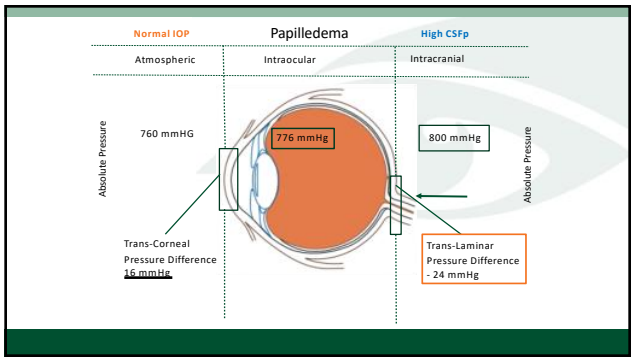

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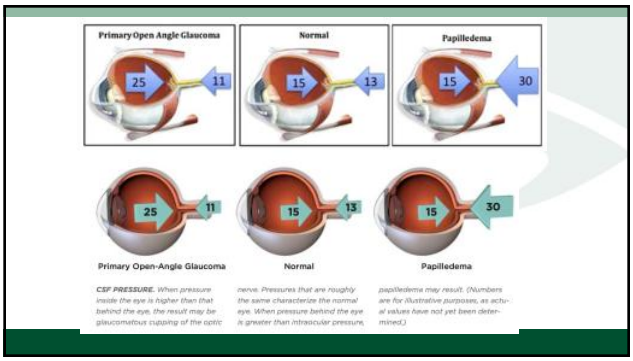

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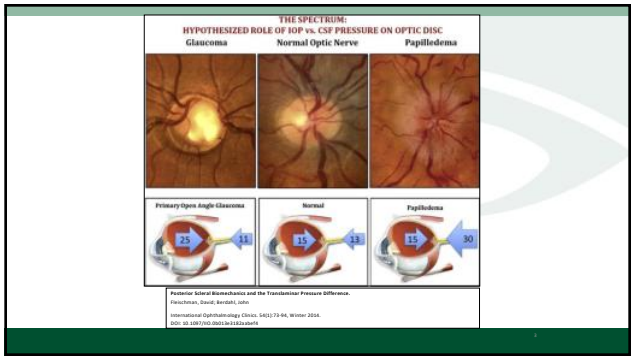

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Glaucoma Today

RESEARCH RESULTS

Cerebrospinal Fluid Pressure and Glaucoma

Intracranial pressure may hold the key to understanding why IOP plays a major role in the development of glaucoma.

BY JOHN BERDAHL, MD

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Compromised Autoregulation in Glaucoma

- **Autoregulation: The body's ability to regulate itself in the presence of change**
  - Vascular factors
    - Cardiovascular disease
    - Vasospasm
  - Postural changes
  - Atmospheric pressure
  - Temperature
  - Fatigue can lead to **abnormal pressure-flow relationship**
- Periods of ischemia are then more likely to occur
  - Can result in reduced or fluctuating OPP

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Autoregulation

Or Vascular Dysregulation…?

- Can lead to over/under perfusion
- Chronic under perfusion can lead to tissue necrosis and death
- Unstable perfusion leads to oxidative stress

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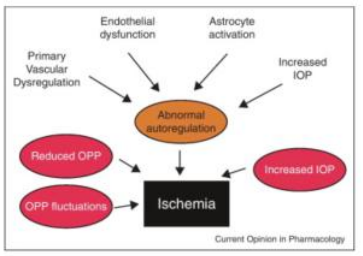
Autoregulation in Glaucoma



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51 y/o Hispanic Female

- Reports shadow peripherally in her LE
- TA: 16-17 on 3 visits

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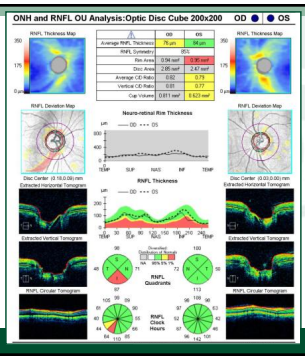

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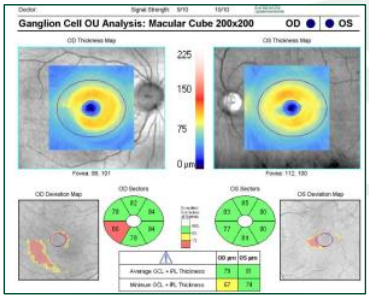

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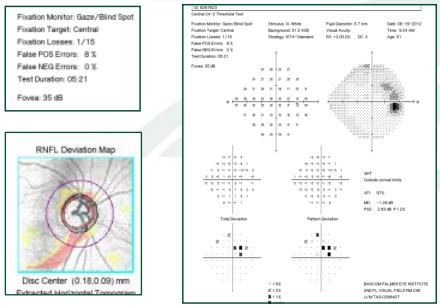


59

How Would You Mange This Patient?

- Is the Normal Tension Glaucoma or POAG?
- Would you treat?
- What would be first line therapy
- Would you set a target IOP?
  - How low do you need to go?

60

51 y/o Hispanic Female
Shadow in LE

- Lumigan 0.01 added – qhs RE
- Returned 3 weeks later – not aware of shadow
  - TA 12/17
- RTC – 4 months

61

Case MC

- 73 yo female presents for follow up: GL Suspect
- Past history single elevated IOP
- BCVA 20/25 and 20/20
- IOP 21 RE 19 LE;
  - CCT 560u R 565u L
- Anterior segment normal
- Mild NS and cortical cataracts

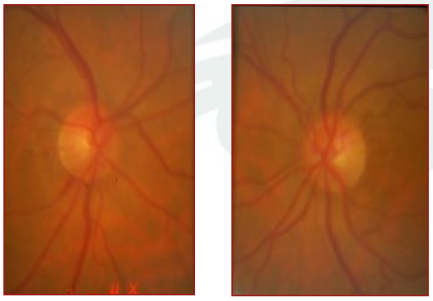
62

The ON

- Small optic discs OU
- RE c/d ~ 0.6 but
  - Appeared saucerized infero temporally
  - Broadening of a vein as it crossed edge disc
  - ? Small disc hemorrhage
- LE c/d .35

63

Photos



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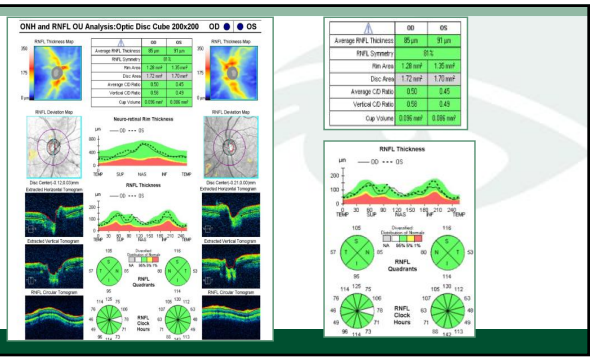

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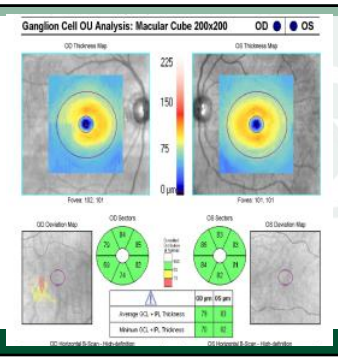

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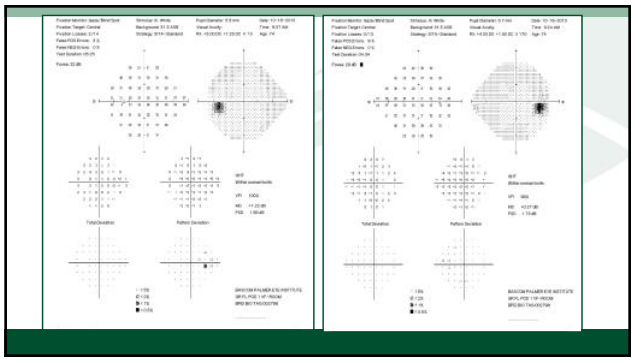


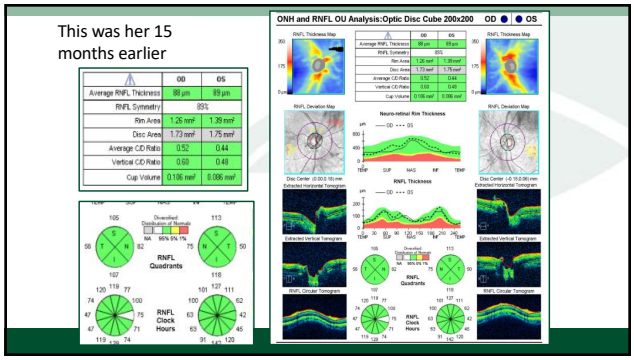
67

Summary

- Suspicious disc
- Borderline IOP
- Normal visual field
- Normal OCT *
- What would you do

68

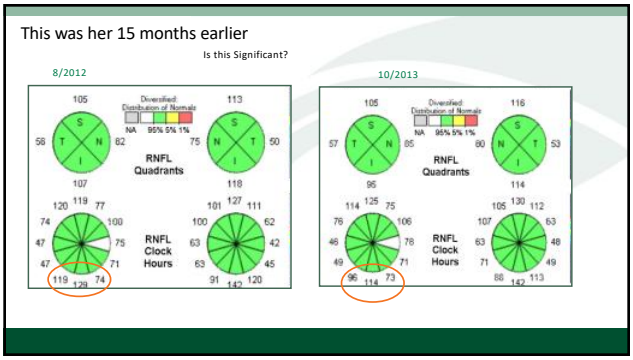
This was her 15 months earlier



69

This was her 15 months earlier

Is this Significant?



70

Is that change significant?

71

How much change needs to occur on an OCT RNFL for it to be significant?

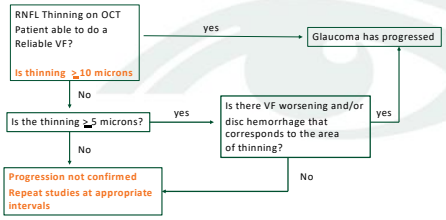
72

How much change needs to occur on an OCT RNFL for it to be significant?

- 5 microns
- 10 microns
- 20 microns
- 25 microns

73

Detecting Glaucoma Progression Using OCT - RNFL

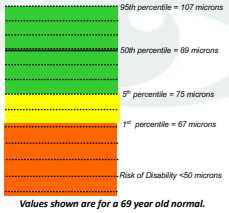


74

Fortunately, SDOCT measurements are highly reproducible.

- *We can measure multiple steps of statistically significant change while a glaucoma suspect still is in the green normal range.*

Normal significance Limits for Average RNFLT

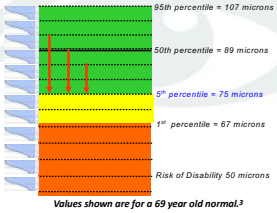


Values shown are for a 69 year old normal.

75

What This Means For Everyday Clinical Care

- *Implication 1: SDOCT can now measure 2 to 4 statistically significant RNFL progression steps for the typical glaucoma suspect while the patient is still is in the green zone.*
- *Implication 2: It may be possible to view SDOCT change from baseline as an early detection strategy in glaucoma suspects.*



Values shown are for a 69 year old normal.[3]

76

Estimating the Lead Time Gained by Optical Coherence Tomography in Detecting Glaucoma before Development of Visual Field Defects

Tammy M. Kuang, MD,[1,2,3] Chunwei Zhang, MD,[1,4] Linda M. Zangwill, PhD,[1] Robert N. Weinreb, MD,[1] Felipe A. Medeiros, MD, PhD[1]

At 95% specificity, up to 35% of eyes had abnormal average RNFL thickness 4 years before development of visual field loss and 19% of eyes had abnormal results 8 years before field loss.

Conclusions: Assessment of RNFL thickness with OCT was able to detect glaucomatous damage before the appearance of visual field defects on SAP. In many subjects, significantly large lead times were seen when applying OCT as an ancillary diagnostic tool. *Ophthalmology 2015;■:1–8 © 2015 by the American Academy of Ophthalmology.*

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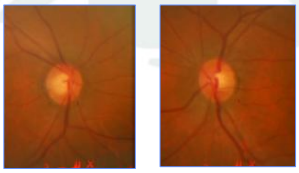
- **Conclusions:** Assessment of RNFL thickness with OCT was able to detect glaucomatous damage before the appearance of VF defects on SAP. In many subjects, significantly large lead times were seen when applying OCT as an ancillary diagnostic tool.

78

Arturo: 50 y/o Russian Male

7/25/12

- RK 1991 -> 20/20 with hyperopic correction: +4.00 +1.50X180
- TA: 32/18
- Pach
  - 544 µ
  - 558 µ
- Gonio -CBB



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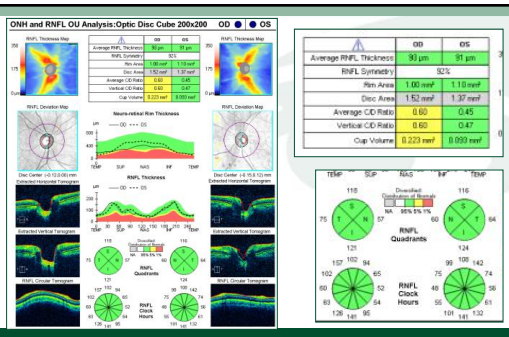

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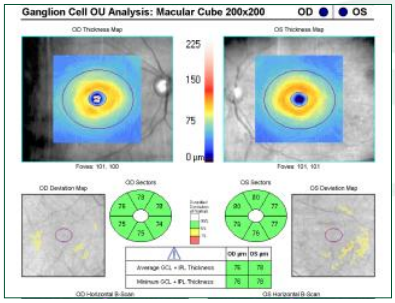


81

What Would You Do Now?

- Obviously he needs a VF
- But would you start treatment now -> on THIS visit?

82

Would you treat Arturo on this initial visit with IOP 32/18 and normal OCT?

1. Yes
2. No

83

20 years of the OHTS

OHTS 1 1994 — OHTS 2 2002 — OHTS 2 2009 ..... OHTS 3 2016-2019

84

Ocular Hypertension Treatment Study (OHTS)

- Long-term randomized, multicentered controlled, clinical trial
- 1500 OHT pts with moderate risk for POAG randomized
  - Observation vs stepped medical therapy
- 5 yr minimum follow up
- Pts seen 2X/year for IOP check and HVF

85

Ocular Hypertension Treatment Study (OHTS)

- 30-40 clinical centers
- Each center randomized minimum of 50 pts
- Men and women 40-80 yo
- IOP
  - ≥ 24, ≤ 32 in 1 eye
  - ≥ 21, ≤ 32 in the fellow eye

86

OHTS: *Arch Ophthalmol* June 2002;120:701-713

- **1636** participants randomized, followed 60 mo
  - Observation vs Treatment
- Goal: Reduce IOP 20% **or** IOP ≤ 24
  - Treatment: reduction 22.5% ± 9.9%
  - Observation: reduction 4.0 ± 11.6%
- **Outcome:** reproducible visual field defect or Reproducible optic disc deterioration

87

OHTS Results: *Arch Ophthalmology* June 2002;120:701-713

- Treatment reduced the chance of developing glaucoma by ≥ 50%
- The chance of developing POAG in 5 yrs:
  - Observation group: 9.5%
  - Treatment group: 4.4%
- Conclusion: **Meds are effective in delaying or preventing the onset of POAG**

88

African Americans and Glaucoma

(Archives of Ophthalmol; June 2004)

African American Population

- Risk of developing POAG doubled
  - Treated group: 8.4% developed POAG
  - Untreated group: 16.1% developed POAG
- Treatment lowered risk of glaucoma by almost 50%

89

Corneal Thickness and OHT

Arch Ophthal June 2002:;120:714-720

- Corneal thickness was a strong predictive factor
- Corneal thickness of < 555 µ had a **3X greater risk** for developing POAG vs pts with thickness > 588 µ
  - African Americans had 23.5 µ thinner corneas than other races – closer to normal
  - Other races had thicker corneas than normal

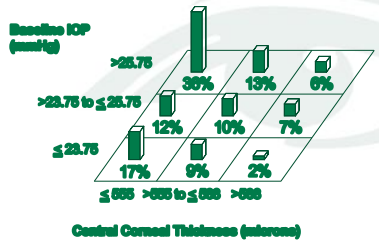
90

OHT: 5 Yr Risk for POAG

- Baseline IOP of 25.75 mmHg
  - Ave Corneal thickness < 556 µ: 36% Risk
  - Corneal thickness 565 to 588 µ: 13%
- Cup-Disc ratio > 0.3
  - Ave Corneal thickness < 556 µ: 24%
  - Corneal thickness 565 to 588 µ: 16%

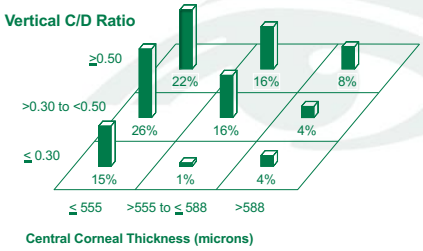
91

POAG Risk Over 5 Years by Central Corneal Thickness and Baseline IOP in Observation Group



92

POAG Risk Over 5 Years by Corneal Thickness and Baseline Vertical C/D Ratio in Observation Group



93

Risk Factors POAG

Arch Ophthal June 2002:;120:714-720

- Thin corneas
- Age
- Cup-disc ratio
- IOP
- Race – but African Americans had thinner corneas and greater vertical C/D ratios
  - Sig in Univariate analyses (59% greater risk), not sig in multivariate analysis
- Reduced PSD at baseline (need multiple VF's)

94

Interpreting Risk

- Expert consensus supports the following guidelines based on the 5-year risk of progressing from OHTN to POAG
  - **< 5%**: observe
  - **5%-15%**: discuss with patient and consider treatment
  - **> 15%**: encourage treatment

Weinreb RN, et al. *Am J Ophthalmol* 2004;138(3):458-467.

95

OHTS 3: 20 Years: 2016 to 2019

- **66%** Retention of study participants **(1078 Pts)**
  (Started with 1636 pts followed 1994 to 96)
  - 67% from the Med group
  - 65% from the observation group
  - 74% (**833**) there is IOP data (known pressure survivors)
    - 493 deceased (**190 had OHTS visit before they died**)
  - 1143 total survivors
- **30%** (488 patients) developed glaucoma by 20 years

96

20 Years of OHTS

- **30% Developed POAG by 20 years?**
  - Medication group: 220
  - Observation group: 266
- 64% developed POAG in only 1 eye
  - Largely a unilateral disease
- 36% developed POAG in 2 eyes
- **72%** of those in the **initial observation** group ended up being on medication

97

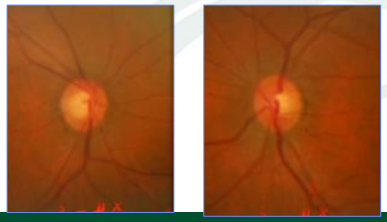
OHTS: Putting it all together

- About 30% develop glaucoma over a 20 year period
- Various risk factors increase may increase that % significantly
  - Older age
  - Thinner cornea
  - Higher IOP
- POAG conversion is largely unilateral
- Most patients with OHTN end up with treatment
  - The risk of converting to glaucoma is about that same as dying (more likely to occur in >70 yo)

98

Back to Arturo: 50 yo Hispanic Male
December 16, 2013

- TA: 27/22

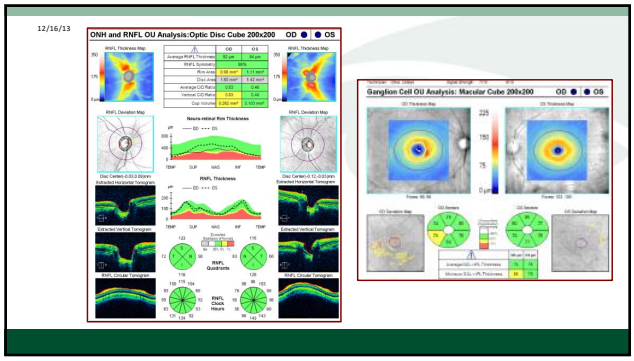


99

Arturo

- Followed without treatment for 4-5 years
- Varying IOP's: Tmax 32/17
  - RE fluctuated 18 -> 29 (32 max on initial visit)

100



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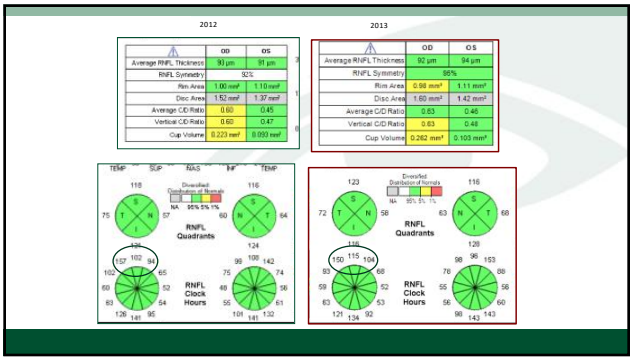

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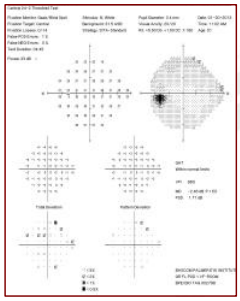
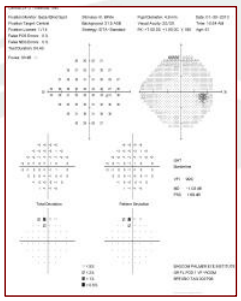
Jan 2013

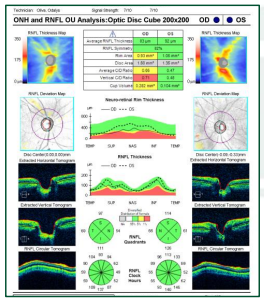




103

11/3/2015

TA 19/17



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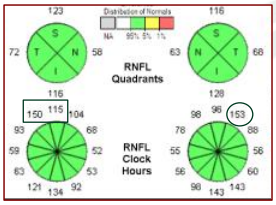
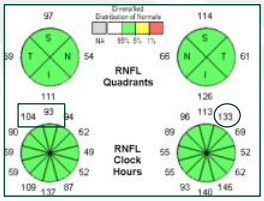
12/16/13



11/3/15



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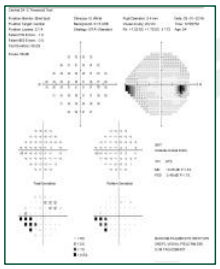
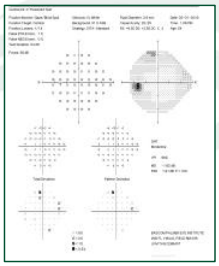
4 Months Later

TA: 29/16





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Arturo

- Being followed for OHTN
  - History of RK
- Variable IOP spikes RE
  - 3/1/16 visit – TA 29
    - Suggestion of VF defect
    - **OCT – probably normal…NOT**
- What do you do?

107

Arturo

- Being followed for OHTN
  - History of RK
- Variable IOP spikes RE
  - 3/1/16 visit – TA 29
    - Suggestion of VF defect
    - OCT – **Thinning in the normal range**

What do you do? **Latanoprost qhs RE started**

- Returned 4/2/16 – TA 20/16

108

Every Day I'm Suffering

Maria

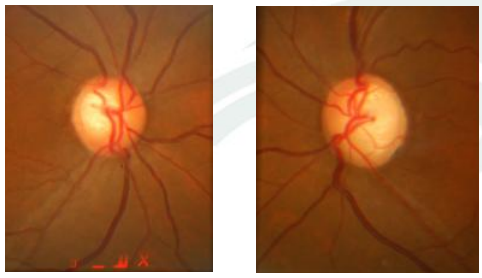
109

57 yo Haitian Female

2009

- Exam for refractive needs – computer glasses
- Has been considered a glaucoma suspect
- Father was blind from glaucoma
- VA: 20/20
- TA 19/16

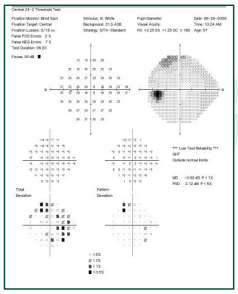
110

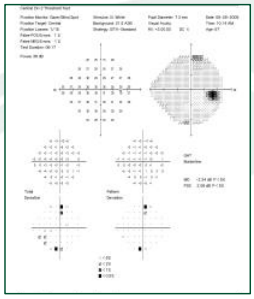


8/23/2009

111

2009





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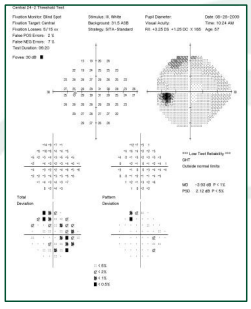

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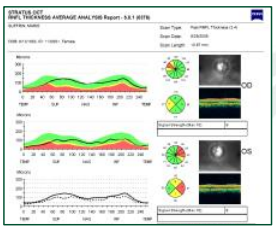
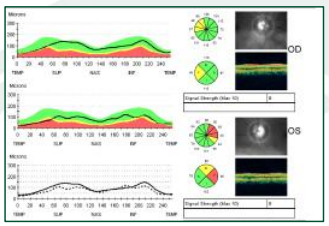




114

Diagnosed as Glaucoma Suspect

- Observed -> No Treatment

115

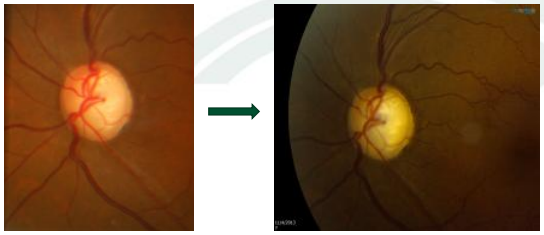
Fast Forward 2013

116

11/4/2013: Ta 14/13

117

2009 2013



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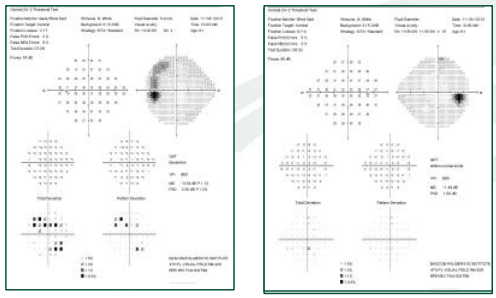

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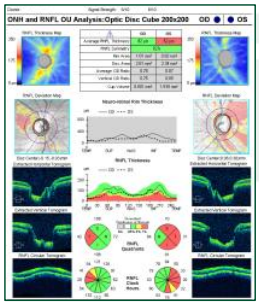

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Does she have glaucoma?

Does she need to be treated?

121

Summary: The Pressure is On

- We recognize there are other factors besides IOP that influence the development/progression of glaucoma
  - We are gaining more and more understanding of these other factors
    - OPP, Low BP, CSF pressure
- But for now – IOP is still the only thing available to treat
- We have great technology to help us diagnose earlier and detect progression earlier
- And maybe even one day soon – we will have a treatment that doesn't involve a drop, laser, or taking a medication

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