The Carter–Jenkins Center presents
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Glaucoma

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Glaucoma

What is it?
How is it diagnosed?
How is it treated?
What is Glaucoma?

Glaucoma is a potentially blinding eye disease usually caused by elevated pressure within the eye.

It is the second-most common cause of irreversible blindness in the USA, after macular degeneration.

It is the most common cause of irreversible blindness in the world.
Visual field with no glaucoma. “Blind Spot” is normal.
Visual Field with severe damage due to glaucoma. Vision in superior hemifield is almost totally lost, but central vision is preserved. It could still be 20/20!
Visual Fields LEFT Eye, on left, and RIGHT Eye. Central vision in LEFT eye may or may not still be preserved.
Series of Visual Fields, showing progressive worsening
How is Glaucoma diagnosed?

By a thorough eye exam, which includes measurement of intraocular pressure and examination of the optic nerve.
How is Glaucoma treated?

Treatment options include eye drops, laser treatment, oral medications, and surgery.
Important things to know about glaucoma

The exact cause of most glaucoma is not known!

It becomes more common as people grow older, but it can affect any age group, including newborn babies!

In most cases it is not CURABLE, but it is CONTROLLABLE.
PRIMARY CONGENITAL GLAUCOMA
First: VISION

- A TOTALLY DETAILED AND COMPREHENSIVE EXPLANATION OF HOW WE SEE IS LACKING
- SIGHT IS INEVITABLY LINKED WITH THE MYSTERY OF HUMAN CONSCIOUSNESS
- SCHRÖDINGER: “CONSCIOUSNESS MAY NEVER BE UNDERSTOOD”
- CLINICIANS ARE MORE LIKE ENGINEERS (MORE LIKE TECHNICIANS?) THAN THEY ARE LIKE SCIENTISTS OR PHILOSOPHERS
- HOW CAN WE REPAIR A MALFUNCTIONING BIOMECHANICAL SYSTEM, SUCH AS THE EYE WITH GLAUCOMA?
Physicist Erwin Schrödinger
Austrian, 1887-1961
\[ H\psi (r, t) = i\hbar \frac{\partial}{\partial t}\psi (r, t). \]

Schrödinger's Equation
Why do we see what we see?

What do you think?
Actually, nobody knows!
Physicist Max Planck
German, 1858-1947
Planck’s Equation

\[ E = h \nu \]
The eye is the camera.

The brain is the computer.

The optic nerve connects the eye to the brain.

Glaucoma can destroy the optic nerve!
Primary Visual Cortex
Where to Parietal Lobe (location, motion)
What to Temporal Lobe ((color, form))
GLAUCOMA FEATURES - 1

- Half the people with glaucoma in the USA are unaware that they have the disease, since it is usually asymptomatic.

- Central vision is usually good until late in the disease; only peripheral vision is damaged.
PROGRESSIVE ATROPHY OF THE OPTIC NERVE, USUALLY ASSOCIATED WITH ELEVATED INTRAOCULAR PRESSURE (IOP)

IT IS UNKNOWN WHETHER THE ATROPHY IS CAUSED DIRECTLY BY MECHANICAL EFFECTS OF PRESSURE, BY RESTRICTION OF BLOOD FLOW DUE TO PRESSURE, OR BY SOMETHING ELSE

DAMAGE, ONCE IT OCCURS, IS PERMANENT
“COAG”

- Chronic Open Angle Glaucoma
- Most common form of glaucoma in U.S.
- Elevated Intraocular Pressure is usually involved
- Exact reason for IOP elevation is unknown
What the doctor sees when he measures your Intraocular pressure by applanation
GLAUCOMA TREATMENT

Only known treatment is to lower the pressure enough so that no more damage occurs.
Glaucoma Treatment: Difficulties

- How low is low enough?
- Too low and the eye goes blind from low pressure!
- Why not do surgery on every eye and get the pressure down once and for all?
- “Perfect” glaucoma surgery (or any surgery) does not exist!
Glaucoma can’t be cured!

- An eye transplant is impossible!
- Can’t cut and resuture the optic nerve!
- 1.2 million nerve fibers in 1.2 mm diameter structure!
- Only known treatment is to lower pressure enough to “freeze” damage that exists and prevent further damage
- How do we know that existing damage is in fact stable?
GLAUCOMA FEATURES – 2

- A clinical parameter used universally to follow glaucoma damage is the so-called “cup/disk ratio”
- This is the ratio of the diameter of the “cupped” region of the nerve to the overall diameter of the nerve
- It is estimated subjectively by the clinician or measured with various imaging devices
Cup/Disk ratio can fool you, due to variation of disk diameter

A normal nerve may have a large C/D

A damaged nerve may have a small C/D

There is no “minimum” C/D that corresponds to “damage”
THE CURRENT “GOLD STANDARD” FOR MONITORING GLAUCOMA DAMAGE IS THE AUTOMATED, COMPUTERIZED VISUAL FIELD TEST

THIS IS A **SUBJECTIVE TEST**, IN THAT IT DEPENDS CRITICALLY ON THE PATIENT’S ATTENTION AND COOPERATION
Optical Coherence Tomography (OCT)

• May someday replace visual fields
• It is objective
• So far, it is not good enough
GLAUCOMA PLUMBING

- If outflow is obstructed by the iris, diagnosis is “angle-closure glaucoma” (common in Asia and in far-sighted people).
- If there is no clinically detectable obstruction of outflow, diagnosis is “open angle glaucoma” = COAG = POAG (more frequent in people of European descent).
Gonioscopy

- Method used clinically to examine the anterior chamber angle
- Every new patient should have gonioscopy, but this is NOT routinely done in eye clinics, even on hyperopes (big mistake)
INTRAOCULAR PRESSURE

- NORMAL IS 10-20 mmHg, OR APPROX 1.01-1.02 ATM
- 1.03 ATM: SLOW DAMAGE (YEARS)
- 1.04 ATM: MONTHS
- 1.05 ATM: DAYS
- 1.06 ATM: HOURS
- 2.00 ATM (SCUBA AT 32 FT): NO DAMAGE!!
GLAUCOMA TREATMENT

- Glaucoma damage cannot be reversed with any known treatment.
- Lowering IOP can stabilize glaucoma and "freeze" optic nerve damage in most cases.
- IOP can be lowered using drops, pills, laser, or surgery.
Glaucoma Treatment

- Drops
- Lasers
- Pills
- Surgery
Glaucoma Drainage Devices

Ahmed Valve® Implant
Tube shunt in eye which has also had previous laser iridotomy
Glaucoma

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The End
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