Glaucoma
Past, Present and Future

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Before we talk about glaucoma, I need to talk a little bit about “The Most Important Square Inch of the Body”
All diagnosed with the ophthalmoscope

- Diabetes
- Hypertension
- Carotid Artery Disease
- Lupus
- MS
- Brain Tumor
- Sickle Cell Anemia
- Leukemia
- AIDS
- Metastatic Disease
- PMR
- Sarcoidosis
- SBE
- IV Drug Abuse
- Syphilis
Fear of going blind

- People are twice as afraid of going blind as they are of dying
Sensory Overload

- 80% of our brain is related to vision
- 60% of sensory input to the cerebral cortex is deprived by vision loss
Visual Imagery – It was raining harder than a cow pissing sideways on a rock.
Glaucoma Past

- Glaucoma has been known in medicine since antiquity.
- Hippocrates described “glaykoseis” as blindness which occurs in the elderly.
- The invention of the ophthalmoscope in 1850 by Helmholtz made it possible to diagnose glaucoma changes in the eye.
- The first effective surgical treatment was carried out by von Graefe in 1856.
- In 1877, Adolf Weber discovered that a drop called pilocarpine could lower the eye pressure.
Glaucoma Present
Glaucoma

- Third leading cause of blindness worldwide
- Second leading cause of blindness among whites in U.S.
- Leading cause of blindness among African Americans in U.S.
Glaucoma

- Affects 2.2 million in US
- Prevalence
  - Age 40 and over - 1.9%
  - Age 75 and over - 7%
  - Blacks 3-4x greater than whites
  - Blacks age 80 and over - 10%
Glaucoma Types

- Some 55 different types
- Open Angle
- Congenital Glaucoma
- Angle closure
Glaucoma - Definition

- Glaucoma is a disease of the optic nerve.
- Most, but not all, patients have a high eye pressure.
Open Angle Glaucoma

Symptoms

None!
Why are patients unaware of their loss of vision from glaucoma until very late in the disease?
The visual loss in glaucoma is usually gradual (over several years), and affects the side or peripheral vision first.
Glaucoma Vision Loss

NORMAL VISION
EARLY GLAUCOMA

ADVANCED GLAUCOMA
EXTREME GLAUCOMA
Open Angle Glaucoma
Prognosis

- Visual loss is irreversible
- When diagnosed early, excellent prognosis for normal vision
- Most cases of blindness are diagnosed at an advanced stage
Glaucoma diagnosis - The optic nerve
Glaucoma - Diagnosis

- We need to determine if the optic nerve is damaged by glaucoma –
  - Visual field testing (peripheral vision)
  - Optical coherence tomography (OCT) – like an ultrasound but with light rays
Comparison of OCT Images

OCT 1
(Time Domain)

Stratus OCT
(Time Domain)

RTVue
(Fourier Domain)

1996

2002

2006
Retinal Layers with RTVue & Histology

Temporal

Fovea

Parafovea

Nasal

Blood vessel

250 µm

Gass J.D.M., 1997

ILM
NFL
GCL
IPL
INL
OPL
ONL
PR IS/OS
RPE
Choriocapillaris
and choroid

THE Ohio State University
WEXNER MEDICAL CENTER
OCT
Glaucoma Progression

The image shows various maps of GCC (Globus Corneal Compensation) thickness, deviation, and significance for different follow-up dates. The maps illustrate changes over time, with colors indicating variations in thickness and significance. The report date is Monday, November 04, 2013, and the software version is 8.0.27. The image also contains a signature, indicating it was reviewed by a healthcare provider.
Glaucoma Treatment

- If you lower the eye pressure, whether it is high, normal or low, you can stop or slow down glaucoma damage.
Glaucoma Treatment
Lowering Eye Pressure

- Eye drops
- Pills
- Intravenous medications
- Laser surgery
- Cutting surgery
Glaucoma Treatment
Eye Drops
Glaucoma Treatment
Eye Drops

- We cannot predict which eye drops will work or be tolerated in any patient
- It is trial and error
Eye Drops
Just approved this year!

- Vyzulta
- Rhopressa
Laser Surgery
Laser Trabeculoplasty
Glaucoma Treatment - Cutting Surgery
Trabeculectomy
Glaucoma Treatment – Cutting Surgery
Glaucoma Tube-Shunt
Trabeculectomy

Canal of Schlemm
Glaucoma Surgery - Present
Minimally Invasive Glaucoma Surgeries – (MIGS) - iStent
Glaucoma Surgery - Present
MIGS - iStent
Glaucoma Surgery - Future MIGS
Glaucoma Surgery – Future MIGS
Glaucoma Future – Education
Ophthalmoscope Simulator
Glaucoma – Future 
New medication delivery
Glaucoma Future

- New medications to lower eye pressure
- Neuro-protective agents
- Optic nerve regeneration
- Gene therapy
  - Gene augmentation
  - Gene silencing
  - Gene editing
  - Genes as drugs
Glaucoma Future

- Why do some eyes with high eye pressure don’t develop glaucoma?
- Why do some eyes with normal eye pressure develop glaucoma?
Two theories we’re doing research on:

- Biomechanical theory
- Low intracranial pressure

- Cynthia Roberts, Ph.D.
- Jun Liu, Ph.D.
- Gloria Fleming, M.D.
- Robert Small, M.D.
Translaminar Pressure Gradient
The Influence of Tonometric Technology and Body Position on the Calculation of the Pulsatile Translaminar Pressure Gradient

Cynthia Roberts, Ph.D.
Gloria Fleming, M.D.
Robert Small, M.D.
Paul Weber, M.D.
Standard Procedure – SLOW while waiting for fluid to rise

It is possible retrospective study used values that were UNDER-ESTIMATED

http://webmedia.unmc.edu/LumbarPuncture/lpProcedure.htm

Electronic Measurement of CSF Pressure during Lumbar Puncture

Transducer

To Pressurized Fluid Reservoir

Plugged into Standard Monitor

To Spinal Needle
Lateral Decubitus (LD) Position
Ultrasound-Guidance of Spinal Needle Placement

SonoSite Model M-Turbo
Reichert Model 30 Pneumatonometer

Produces a strip-chart, rather than a digital output.

Doctoral student, Ryan Somogye, designed and built an interface to allow direct connection with patient monitor - used for a subset of the later subjects.

This allowed direct subtraction of signals.
Is there any practical way to evaluate this issue?
OCT Reflectivity

- Changes in OCT reflectivity of the lamina cribrosa result from changes in the stress distribution of the lamina
Sitting
Supine
OCT Reflectivity
Thank You!