Overview

- Beyond (Retina) First
  - History/principles of the OCT
  - What does the normal retinal OCT look like
  - Vitreal disorders
  - Retinal/RPE disorders
  - Choroidal disorders
- Glaucoma
  - What does the normal ONH OCT look like
    - rNHL
    - GCA
    - ONH disorders

History of OCT

- 1991: 1st scientific description of the OCT
- Original Founders:
  - David Huang, M.D., PhD
  - Dr. James Fujimoto, PhD
  - Eric Swanson, MS
  - Carmen Puliafito, M.D.
  - Joel Schulman, M.D.
- Introduced commercially in the mid-1990's

The Beginning OCT

- 1995 OCT1 debuted at 100 axial scans per second with a resolution of 20 microns

Evolving the OCT

- Stratus OCT – 2002
  - "Time domain"
  - 500 axial scans/second
  - 10 micron resolution

- "Spectral-Domain" OCT – 2007
  - "Fourier-Domain"
  - 27,000–40,000 axial scans/second
  - Analyzes data using a spectrometer
  - Does not use a moving mirror
  - Very fast acquisition speed
  - 65x greater acquisition speed
  - 3-D imaging
  - 3.5 – 6 micron resolution
Understanding and Interpreting the Retina OCT

- Choroid
- 10 layers of the retina
  - RPE
  - Photoreceptors
  - ELM
  - Outer nuclear layer
  - Outer plexiform layer
  - Inner nuclear layer
  - Inner plexiform layer
  - Ganglion cell layer
  - Nerve fiber layer
  - ILM
- Vitreous
Unilateral, decreased vision
- Often in 60-80 year old women
- Anyone w/ a history of trauma

Symptoms:
- Decreased vision, metamorphopsia
- 20/200 for full thickness holes

Signs:
- Red hole in the macula
- (+) Watzke-Allen sign

Stages
- Stage 1a -> impending hole. Normal foveal depression with yellow spot/dot in fovea.
- Stage 1b -> Abnormal foveal depression with yellow ring.

Stage 1b macular hole
Stages
- Stage 2: Small full-thickness hole. 20/80 - 20/400.
- Stage 3: Full-thickness hole w/ cuff of SRF. No PVD
- Stage 4: Full-thickness hole with cuff of SRF, with complete PVD.

New Macular Hole Staging

Table 1. Correlation between Commonly Used Macular Hole Stages and the International Vitreomacular Traction Study Classification System for Vitreomacular Adhesion, Traction, and Macular Hole

<table>
<thead>
<tr>
<th>Full-Thickness Macular Hole Stage in Common Use</th>
<th>International Vitreomacular Traction Study Classification System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1: Small FTMH w/o traction</td>
<td>Stage 2: Small FTMH w/o traction</td>
</tr>
<tr>
<td>Stage 2: Small FTMH w/ traction</td>
<td>Stage 3: Medium FTMH w/ traction</td>
</tr>
<tr>
<td>Stage 3: Medium FTMH w/ traction</td>
<td>Stage 4: Large FTMH w/ traction</td>
</tr>
<tr>
<td>Stage 4: Large FTMH w/ traction</td>
<td>Stage 5: Vitreomacular adhesion</td>
</tr>
</tbody>
</table>

Frame 7/9/18
Large FTMH with traction > 400 microns

Macular Hole

- Treatment:
  - Stage 2 holes or beyond (full thickness macular holes)
  - Vision 20/40 or worse
  - How long has the hole been there???
  - Vitrectomy & membrane peel
  - Face down???

- Prognosis:
  - 20/40 or better in up to 65% of cases

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Lamellar Macular hole

- “Partial thickness macular holes”
- Aborted macular holes
- “Upside down anvil” “anvil-like”
- VA -> usually 20/40 or better
- 4 characteristics
  1. Irregular foveal contour
  2. Break in inner fovea
  3. Intraretinal split
  4. Intact foveal photoreceptors

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**Pseudohole**

- “False hole”
- Simulates macular hole w/o actual tissue dehiscence
- Full thickness retinal tissue is still present
  - Not an anvil
- VA
  - Usually 20/20 – 20/30 unless significant ERM is present

**4 Basic Categories: Diseases of the...**

- Vitreous
- Neural-Sensory Retina
- ERM
- Choroid

**Before Tx**

**3 weeks after Tx**
Central Serous Chorioretinopathy (CSR)

- Demographics
  - 25-50 year old men, stressed/Type A personalities

- Symptoms
  - Unilateral, blurred vision
    - VA: usually 20/20–20/80
  - Metamorphopsia

- Signs
  - Localized serous detachment of the neurosensory retina in the macula

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Central Serous Chorioretinopathy

- DDx:
  - Optic disc pit
  - CNVM

Central Serous Chorioretinopathy

- Med associations:
  - Steroids
    - Nasal sprays, steroid creams, oral, injectable
    - Ephedra
      - Ephedrine & pseudoephedrine

- Treatment:
  - Observation/lifestyle change
  - D/C steroid if possible
  - Possible laser therapy

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Antimalerials:
- Chloroquine
- Hydroxychloroquine (Plaquenil)
- Now used for RA, SLE, Sjogren’s, etc.

Toxicity risk is low, but….
Lots of different screening recommendations have been proposed.

Risk Factors:
- Cumulative dose
  - 1000 gram cumulative dose for Plaquenil
  - 6.85 years to reach that
- Daily dose
- Age
- Liver or kidney dysfunction
- Pre-existing retinal disease or maculopathy

Symptoms:
- Asymptomatic early
- Paracentral visual field defects affecting reading
- Color vision changes

Signs:
Plaquinil Toxicity

- Recommended Screening Guidelines:
  1. Baseline exam within the first year of starting Plaquinil
     - Biomicroscopy exam 10-2 VF, Fundus photos, OCT
  - After 5 years, annual screening exams
     - SD-OCT or
     - mfERG or
     - Fundus autofluorescence

Case #5

- OD – September 2011
- OS – September 2011

Plaquinil Toxicity

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     - Biomicroscopy exam 10-2 VF, Fundus photos
     - SD-OCT or mfERG or fundus autofluorescence
  - After 5 years, annual screening exams
     - Biomicroscopy exam along with 10-2 VF and
     - SD-OCT or
     - mfERG or
     - Fundus autofluorescence

Plaquinil toxicity “saucer sign”
Tests not recommended for screening
- Fundus photography
- Time-domain OCT
- FA
- Full-field ERG
- POG
- Color vision testing
- Amsler grid
Treatment:
- No medical therapy is available to treat/cure the toxicity
- D/C the med if possible
- Work with the PCP
Dry Age-related Macular Degeneration (AMD)

Dry AMD

One other case – a hint it’s not AMD
Dry Age-related Macular Degeneration (AMD)

**Impression:**
1. Macular pucker syndrome, possibly a small area of atrophy, possibly a very early stage of age-related macular degeneration. At the current level, no treatment is needed besides routine observation and monitoring.

I have discussed with him that his left eye should be checked by an ophthalmologist for at least one visit to and out in a few months and see if you have any new or sudden changes. Beyond that, we have given him information about vitamin supplementation and have not seen him up for an immediate follow-up with us here, but of course we would be happy to visit with you if new or sudden changes were to occur.
OCT Angiography: the Next Chapter in Posterior Imaging

- Images retinal microvasculature without dye injection
- Displays structure and function from a single imaging system

Structure & Function from One System

A New Approach to Visualizing Blood Flow

- Patient Benefits
  - Reduces patient burden to allow more frequent imaging
  - Avoid potential side-effects of fluorescein injection
- Clinical Benefits
  - Faster than a dye-based procedure
  - Ultra-high resolution imaging of retinal microvasculature
  - 3D visualization: segments retinal vasculature into individual layers

OCT-Angiography

How Does it Work?
Principles of OCTA

OCTA uses motion contrast to detect flow from OCT data
- Rapidly acquires multiple cross-sectional images from a single location on the retina
- Flow is the difference in signal between two sequential B-scans

Difference of Two OCT B-scans

Enface OCTA Generated from OCTA Volume Data
- Multiple motion contrast frames create 3D OCTA volume
- Enface visualization of layers obtained by slicing and projecting slabs from 3D OCTA data

Deep Plexus (INL–OPL)
Superficial Plexus (IPL–IPL)
Outer Retinal Zone (ONL–BM)
Choroidal Capillaries

OCT-ANGIOGRAPHY
**OCT-A in our clinic**

**Indications:**
- AMD – dry vs. wet
- Diabetics: is there nonperfusion (capillary dropout)?
- Vein Occlusions
- Glaucoma: nerve perforation?

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**INTERPRETING RETINAL OCT’S & INTRODUCING OCT-ANGIOGRAPHY**

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