CHOROIDAL OCT IMAGING

PURPOSE
- Review choroidal OCT imaging capabilities in healthy eyes.
- Outline disease specific choroidal OCT findings.
- Demonstrate clinical applications using case examples.

CHOROIDAL OCT IMAGING

- Unexplored choroid
- Evolving capabilities
  - TD-OCT
  - SD-OCT
  - EDI-OCT
  - SS-OCT up to 1000nm
- Choroidal OCT imaging limitations
  - Ocular media
  - Mid-peripheral/peripheral location
  - Posterior extent of lesion
  - Intralesion characteristics
- Evolving role of choroidal OCT
  - Detailed in vivo information
  - Complements existing imaging techniques
  - Disease specific OCT patterns
  - Early detection

SPECTRAL DOMAIN OCT

ENHANCED DEPTH OCT

ULTRASONOGRAPHY vs. OCT

ULTRASONOGRAPHY
- Advantages
  - Bypasses poor ocular media
  - Peripheral lesions
  - Intra-lesion echogenicity
  - Posterior evaluation of lesions
  - Thickness measurements
- Disadvantages
  - May overestimate tumor thickness
  - Difficulty detecting subretinal fluid <100µm
  - Limited characterization of small tumors

SD-OCT
- Advantages
  - Microstructural extrinsic effects
    - Retinal abnormalities
    - Subretinal fluid (presence, location)
    - RPE abnormalities
    - Choroidal abnormalities
  - Thickness measurements
- Disadvantages
  - Inherent limitations of using optical light
  - Field of view: 1mm height x 9mm width
**(CHOROIDAL NEVUS OCT imaging)**

**OCT PATTERN**
- Abnormalities common
- "Gentle mound" RPE contour
- Choriocapillaris compression
- Posterior origin
- Choroidal vascular spaces maintained within lesion.
  - 60% hyporeflective
  - 30% isoreflective
  - 10% hyperreflective

**CHOROIDAL NEVUS OCT imaging**

**EDI-OCT PATTERN**

*Melanocytic Nevus*
- Highly reflective band

*Amelanocytic Nevus*
- Medium reflective band

**(CHOROIDAL OCT IMAGING)**

Which nevi should be imaged?
- Thickness approaching 2mm*
- Diameter approaching 5mm
- Orange pigment*
- SRF observed clinically*
- Visual disturbance*
- Peripapillary locus*
- Absence of drusen
- Growth

* TFSOM risk factors

**(CHOROIDAL NEVUS OCT imaging)**

**Shah et al. study of 51 choroidal nevi**

**EDI-OCT vs. CLINICAL**

<table>
<thead>
<tr>
<th>Sign</th>
<th>EDI-OCT</th>
<th>CLINICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent PR layer</td>
<td>43%</td>
<td>49%</td>
</tr>
<tr>
<td>Disorganized RPE layer</td>
<td>37%</td>
<td>42%</td>
</tr>
<tr>
<td>Bruch's membrane intact</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>SRF</td>
<td>14%</td>
<td>8% [0% US]</td>
</tr>
<tr>
<td>RPE atrophy</td>
<td>4%</td>
<td>14%</td>
</tr>
<tr>
<td>RPE hypertrophy</td>
<td>9%</td>
<td>14%</td>
</tr>
<tr>
<td>Drusen</td>
<td>90%</td>
<td>92%</td>
</tr>
<tr>
<td>Choroid/Bruch's line</td>
<td>94%</td>
<td>94%</td>
</tr>
<tr>
<td>PED</td>
<td>4%</td>
<td>4%</td>
</tr>
</tbody>
</table>

**(CHOROIDAL NEVUS OCT imaging)**

**SIMPLE CHOROIDAL NEVUS**

- Small, elevated (< 5mm)
- Clinical appearance: simple benign choroidal nevus
- Atypical OCT pattern

**VS.**

- Small, elevated (< 5mm)
- Choroidal amelanocytic lesion.
- Clinical appearance: amelanocytic nevus
- Atypical OCT pattern.

**(CHOROIDAL NEVUS OCT imaging)**

**SIGNS of CHRONICITY**

- Retinal edema/thickening
- RPE changes/detachment
- PR changes

**EDI-OCT vs. ULTRASONOGRAPHY**

- US mean thickness: 1.5mm
- EDI-OCT mean thickness: .685mm

**(CHOROIDAL NEVUS OCT imaging)**

**SIMPLE CHOROIDAL NEVUS**

- 3mm x 3mm x 0mm pigmented choroidal melanocytic lesion.
- (+) overlying drusen
- (-) orange pigment, SRF
- Typical OCT pattern.
**CHOROIDAL NEVUS OCT imaging**

**GIANT CHOROIDAL NEVUS**
- 66 YO asymptomatic white male
- Visual acuity: 20/20
- 10mm x 10mm x <0.5mm choroidal melanocytic lesion.
- Typical OCT pattern.

**SUSPICIOUS CHOROIDAL NEVUS**
- 2005 – 59 YO asymptomatic white female
- Visual acuity: 20/25
- Flat, suspicious choroidal nevus noted temporal OS
- Longstanding per patient history.
- Orange pigmentation, hemes, exudate
- RTC 3 months for photos
- Lost to F/U for 5 years.

**CHRONIC OCT PATTERN**

**CHOROIDAL MELANOMA OCT imaging**

**MEDIUM/LARGE MELANOMA**
- OCT typically unusable.
  - Large tumors found more in periphery.
- 99% accuracy using A-scan, B-scan, fluorescein angiography, and clinical appearance.

**SMALL MELANOMA**
- Observed growth in 30% @ 5 years.
- Rule of OCT in this subgroup?
  - Tumors not adequately imaged with US (~<1mm thickness)

**CHOROIDAL NEVUS vs. SMALL CHOROIDAL MELANOMA**

**Clinical Predictors of Growth**
- Thickness > 2.0mm
- Evidence of growth
- Orange pigment
- Juxtapapillary location
- Posterior location
- Visual disturbance: blurred
- Absence of drusen/chronic RPE changes

**Clinical Predictors of Metastasis**
- Tumor thickness >2mm
- Basal diameter >1mm
- Subfoveal location
- Visual disturbance
- Advanced age
- Observed tumor growth
- Observed tumor thickness

**Clinical Predictors of SD-OCT Patterns**
- SRF present: melanoma > IML > nevus
- SRF location: inferior margin > inferior margin > apex > apex
- Active SRF vs. chronic localized RD
- SRF & abnormal PR in choroidal nevus
  - Fresh SRF: shaggy PRs
  - Chronic SRF: intra-arterial PR

**SRF PATTERNS**

**CHRONIC OCT PATTERN**

**SRF PATTERNS**

**CLINICAL SIGNIFICANCE**

**PREVIOUS VALUE**
- Risk factor for growth in small choroidal melanocytic tumors.

**SPECIFICITY**
- Overlapping findings in choroidal nevi and choroidal melanoma.
- Prevalence: 91% melanoma vs. 25% nevus

**OPTIMAL DETECTION?**
- Ultrasonography
- Fundoscopy
- SD-OCT
CHOROIDAL OCT clinical application

CHOROIDAL MELANOMA

2011

- 62 YO WM presenting to VA for routine exam.
- Previously monitored by retina specialist for choroidal nevus OD 10 years ago = lost to F/U.
- Denied visual disturbance: 20/20 OD, OS
- Elevated, 7mm x 6mm pigmented choroidal mass with overlying orange pigment & SRF, touching the inferior optic disc margin.
- Obtained records revealed doubling of tumor size.

SMALL MELANOCTIC LESION

2008

- 68 YO asymptomatic WM
- 2DD flat choroidal nevus inferior to macula OS
- BCVA 20/20 - 2009
- 2DD, elevated choroidal nevus OS
- (+) drusen, (-) lipofuscin
- OCT revealed serous RD/juxtapapillary location
- Referred to ocular oncologist.
- Diagnosed with suspected choroidal nevus with overlying serous RD.
- Enrolled in Melanoma Study

SUSPICIOUS OCT SIGNS

- SRF + retinal thickening
- Shaggy PR

CHRONIC OCT PATTERN

- DRusen
- SRF
- Shaggy PR

CHOROIDAL PSEUDOTUMOR OCT imaging

CHRPE OCT PATTERN

- Retinal thinning
  - Complete PR loss + intact inner retina
- Intraretinal cystoid spaces
- Subretinal fluid (SRF) vs. SRF
- Shaggy PRs
- RPE hypertrophy/thickening
- Normal choroid

CHOROIDAL METASTASIS OCT imaging

CHOROIDAL METASTASIS

2007

- 59-year-old black male
- Presenting for routine examination
- (-) Visual disturbance
- Visual acuity: 20/20 OU
- 4mm x 4mm x 0mm choroidal nevus with coalesced drusen OD

2005

- 62 YO asymptomatic WM
- 2DD flat choroidal nevus OD
- BCVA 20/20

MEDICAL HISTORY

- Large-cell lung cancer + brain metastasis
  - S/p pneumonectomy in 2004, 4 cycles carboplatin/paclitaxel
- Substance abuse

CHOROIDAL METASTASIS

2013

- 4mm x 4mm x 1mm non-pigmented choroidal tumor
- Diffuse overlying RPE hypertrophy, orange pigment, intraretinal hemorrhages, and inferior subretinal fluid OD
AMD vs. POLYPOIDAL CHOROIDAL VASCULOPATHY

- Choroidal thickness
  - PCV > normal > exudative/dry AMD.
  - Potential for identifying subset of patients with PCV
- Chung et al.
  - PCV eyes: 438 µm
  - Fellow eyes: 372 µm
  - Normal controls 224 µm
  - Exudative AMD eyes: 171 µm
  - Early dry AMD eyes: 177 µm
- Cystic retinal changes
  - PCV < AMD
- Visualize polypoidal structures
  - Beneath RPE

AGE RELATED CHOROIDAL ATROPHY

- Clinical phenotype:
  - Reduced BCVA
  - mean age 80 years
  - tessellated fundus
  - 30% concurrent AMD
  - 30% concurrent glaucoma.
- Pathogenesis: age-related choroidal sclerosis
- Average subfoveal CT: 70µm

CENTRAL SEROUS CHORIORETINOPATHY

- Clinical phenotype: Macular neurosensory retina detachment in young males.
- Etiology: Choroidal hyper-permeability thought to be underlying cause.
- EDI-OCT findings:
  - Increased subfoveal CT in both eyes.
  - Double-layer sign (visible splitting of RPE/Bruch’s): seen in chronic > acute CSC.
  - Dilated choroidal vessels in areas of ICG hyperfluorescence.
  - Inner choroidal layer thinning in area of dilated choroidal vessels.
  - RPE detachment
  - RPE rips

CASE example

- 85 YO WM with acute onset macular serous RD
- Pituitary adenoma with secondary hypocortisolism: treated with oral hydrocortisone 25mg/day.

CHOROIDAL OCT summary

- Choroidal OCT imaging likely to be a common modality in future OCT devices.
- Anticipate improving EDI-OCT techniques.
- Disease-specific features will be refined, but already relevant in clinical practice.