Pathogenesis, Staging, and Classification of VMT and Macular Holes

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Disclosures

• Consulting Fees: ThromboGenics
• Speaker: ThromboGenics
VMI Disease

Background – Why The Interest in 2013?

- New findings based on SD OCT
- Better understanding of pathogenesis
- Surgical outcomes linked to OCT findings
- Need to speak a common language – new Classification system
- New therapies – ocriplasmin (Jetrea)
VMI Diseases

Outline of the Talk

• Pathophysiology of diseases of the vitreomacular interface (VMI)
• OCT-based definition, diagnosis, and classification of:
  – Vitreomacular adhesion (VMA)
  – Vitreomacular traction (VMT)
  – Full-thickness macular hole (FTMH)
VMI Diseases

The Importance of the Vitreo-Retinal Relationship:

- Ophthalmologists must now be able to identify vitreomacular pathology at early stages when treatment may be most effective

- This is based on optical coherence tomography
Almost All Acquired Vitreomacular Interface Pathology is the Result of Anomaly in the Normal Vitreous Aging

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Two processes occur with age:
1) progressive vitreous liquefaction
2) progressive weakening of the vitreoretinal adhesion

collagen, fibronectin, laminin
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Liquefaction

- Liquid vitreous seen in eyes by 4 yrs old
- By late teens, approximately 20% of the vitreous volume is liquid
- Liquefied lacunae increase with age in number, size, and coalescence
- By 70 years, > 50% of vitreous is liquefied
- Despite liquefaction, no PVD in most autopsy eyes < 60 years
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Weakening of Vitreoretinal Adhesion

- Progressive age-related weakening of adhesion between posterior vitreous cortex (posterior hyaloid) and internal limiting membrane (ILM)
- > 60 yrs, significant correlation between liquefaction and PVD, because at that point, the vitreoretinal adhesion becomes sufficiently weakened to allow separation
• Posterior vitreous detachment
  Incidence = age
Posterior Vitreous Detachment (PVD)

- Contrary to popular thought, PVD is not an acute process culmination in the formation of a Weiss ring with associated symptoms.
- Rather, it is a long-term, chronic process typically occurring over decades that sometimes culminates in the clinical manifestations of acute PVD.
Evolution of PVD = Johnson Classification Scheme

- PVD begins in perifoveal macula (Stage 1)
- Extends next into superior and temporal midperiphery then into fovea (Stage 2)
- Then inferior midperiphery (Stage 3)
- Finally the optic disc margin resulting in complete PVD – often with Weiss Ring (Stage 4)

Vitreomacular Pathology: Anomalous PVD

- Persistent vitreous traction on fovea and/or disc
- Epiretinal avascular proliferation
- Results in anatomic retinal changes
  - Retinal distortion
  - Retinal thickening
  - Intraretinal cyst formation
  - Subretinal fluid
  - "Schisis" - splitting of inner/outer retinal layers
  - Macular hole formation – full and/or lamellar
Most Vitreomacular Pathology: Anomalous PVD

- Retinal pathology typically develops where vitreous attached to retina most firmly
- Four areas:
  - Vitreous base
  - Along large retinal vessels
  - Optic disc margin
  - Two macular locations
    1) A 500-micron radius “foveolar attachment”
    2) A 1500-micron radius “foveal attachment”
• When vitreous gel detaches, retina tears in 5% – this leads to retinal detachment
Macular Complications of Anomalous PVD

- **Focal**, small (< 500 microns) vitreous adhesions → traction on foveola
- Results in focal macular pathology:
  - Vitreomacular traction (VMT)
  - Cystoid spaces
  - Subretinal fluid
  - Macular hole (FTMH)
  - Lamellar macular hole (LMH)
OCT-Aided Insights into Macular Complications of Incomplete PVD

- **Broad**, large adhesions result in lower tractional forces
- >1500 micron vitreomacular adhesions are less likely to cause macular dehiscence
- More likely to cause diffuse disease
  - Epiretinal membrane
  - Traction macular detachment
  - Myopic macular schisis
  - Hyaloidal thickening in diabetes
  - May be related to DME, AMD, RVO
VMI Diseases

International Classification of Diseases of the Vitreomacular Interface (VMI)

- International panel convened in 2012 to devise a new classification system for VMI disease
- Strictly Anatomic – OCT-based
  - Objective
  - Not based on clinical findings
  - Not based on symptoms
- Simple, easy to use, predictive of surgical and pharmacological outcomes
VMI Diseases

International Classification of Diseases of the Vitreomacular Interface (VMI)

USA
• Jay Duker
• Peter Kaiser
• Elias Reichel
• Vas Sadda
• Jerry Sebag
• Richard Spaide

Europe
• Sussane Binder
• Marc deSmet
• Alain Gaudric
• Peter Stalmans
VMI Classification System: One Finding, Five Diseases

- **“Finding”**: Vitreomacular Adhesion (VMA)
- **Diseases**:
  - Vitreomacular Traction (VMT)
  - Full Thickness Macular Hole (FTMH)
  - Lamellar Macular Hole (LMH)
  - Epiretinal Membrane (ERM)
  - Myopic Macular Schisis
VMI Diseases

Vitreomacular Adhesion (VMA)
VMI Diseases

VMA - Intl Classification Definition

- Posterior vitreous cortex (posterior hyaloid) visible on or above retinal surface
- Posterior vitreous cortex detached from inner retina at some point in the perifoveal area
- Persistent macular attachment, some part of which is attached within a 3-mm radius of fovea
- No anatomic retinal changes on OCT
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VMA Definition

• VMA is essentially a perifoveolar PVD
• VMA would be considered a stage 1 PVD by Johnson’s classification
Vitreomacular Adhesion (VMA)

- **Exclusively an OCT finding**
  - No: symptoms
  - No: clinical findings
  - Must be present on at least one OCT B scan (line scan) through the fovea
  - Perifoveolar PVD
- **Due to age-related changes of the vitreous**
- **Rarely pathologic**
- **Common**
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Two VMA Subclassifications

1) **Focal** versus **broad**
   - Focal attachment < 1500 microns
   - Broad attachment > 1500 microns
   - Broad VMA roughly parallel to the RPE and may include focal areas of cortex dehiscence

2) **Isolated** versus **Concurrent** → with other macular disease
   - Note: symptoms are NOT a part of the definition
   - Note: VMA may resolve, persist, or go on to VMT
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Focal versus Broad

- **Why 1500 microns?**
  - Known site of strong VM adhesion by histology
  - Pre-existing cut-off employed by reading centers
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Focal VMA

Broad VMA
Isolated versus Concurrent

- **Isolated** = isolated finding on OCT in absence of posterior segment disease
- **Concurrent** = associated with a posterior segment disease
  - VMA may or may not be directly attributable to concurrent disease
  - Visual effects, if present, may be due to VMA or the secondary disease or both
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VMA Usually Spontaneously Resolves...But When It Doesn’t....

Vitreomacular Traction (VMT)
Vitreomacular Traction (VMT) – International Classification

- Definition = VMT is VMA with ANY abnormal macular retinal architecture
- OCT diagnosis
- “Symptomatic VMA” = VMT
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VMT Definition

- Posterior vitreous cortex (posterior hyaloid) visible on or above retinal surface. May be thickened.
- Posterior hyaloid detached from inner retina at some point in the perifoveal area
- Persistent macular attachment within a 3-mm radius of fovea
- Anatomic retinal changes on OCT
- ALWAYS pathological
- May or may not be symptomatic
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Vitreomacular Traction (VMT) – very mild, no symptoms
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Two VMT Subclassifications

1) *Focal* versus *broad*
   - Focal attachment < 1500 microns
   - Broad attachment > 1500 microns
   - Broad VMA roughly parallel to the RPE and may include focal areas of cortex dehiscence

2) *Isolated* versus *Concurrent* (with other macular disease)
VMI Diseases

Vitreomacular Traction (VMT)

- VMT = VMA with retinal architectural changes

focal
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Clinical Course of VMT

• Spontaneous PVD
  – Usually with regression of symptoms
  – Cystoid spaces may persist
  – Vitreoschisis may still lead to ERM formation

• Stability

• Progression
  – Severe retinal anatomic distortion
  – FTMH
  – LMH
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VMT Course – Spontaneous PVD

- 62 yo female, c/o distortion x 1 month
- VA = 20/40

Courtesy of Carl Regillo, MD
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2 months later

OS
20/40

Courtesy of Carl Regillo, MD
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3 months later

VA = 20/25

Persistent cystoid space

Courtesy of Carl Regillo, MD
VMI Diseases

6 months later

VA = 20/20

Courtesy of Carl Regillo, MD
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Full Thickness Macular Hole (FTMH) - International Classification System
VMI Diseases

FTMH Anatomy and Outcome-Based Intl. Classification System: 3 Factors

1) **Size** of defect
2) **VMT** = present or absent
3) **Primary** versus **secondary**

• **Note:**
  – Not a “staging” system
  – No longer an “idiopathic” condition = Now referred to as Primary. Due to VMA \( \rightarrow \) VMT

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FTMH Classification – Aperture Size

• **Small** = full-thickness retinal defect ≤ 250 µm
• **Medium** = full-thickness retinal defect > 250 µm and ≤ 400 µm
• **Large** = full-thickness retinal defect > 400 µm
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Size Not Stage Critical for Surgical Outcome

• “Aperture Size”
• Based on OCT measurement
• Horizontal line roughly parallel to RPE measuring the smallest hole diameter in a foveal B scan
• Don’t measure at inner retina – mid retina or outer retina

• OCT caliper function used to measure hole at narrowest width

192 microns
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FTMH Subclassification – Small (< 250 microns)
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FTMH Subclassification – Medium (251 – 400 microns)

390 microns
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FTMH Subclassification – Large (> 400 microns)

516 microns
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Measure Here

Not Here
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Why 250 micron and 400 micron Cut-Offs for Aperture Size?

- Ocriplasmin data suggest that best results are for small macular holes < 250 microns and holes > 400 microns have not closed.
- Clinical studies suggest spontaneous closure only occurs in macular holes < 250 microns.
- Clinical studies show surgical success rate for hole closure has a “pivot point” at 400 microns.
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FTMH Subclassifications - VMT

- FTMH with VMT present
- FTMH with VMT released
  - Under Gass classification – this would have been a stage 4 macular hole regardless of size

90 microns

Small FTMH – VMT released
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FTMH – VMT Present or Absent

Small FTMH – VMT present

Small FTMH – VMT released
Stage 1 Macular Hole vs Isolated Focal VMT

VMT can affect inner retina or outer retina
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Secondary FTMH

• Pre-existing or concurrent condition or disease without evidence of VMT
  – Trauma
    • Blunt trauma
    • Lightning strike
    • Surgical procedure
  – Myopia
  – Macular schisis
  – MacTel Type 2
  – Choroidal neovascularization (CNV) treated with anti-VEGF
<table>
<thead>
<tr>
<th>VMI Diseases</th>
<th>Macular Hole - Old Versus New</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Old (Based on Gass)</strong></td>
<td><strong>New (Intl Classification)</strong></td>
</tr>
<tr>
<td>Stage 0 macular hole</td>
<td>VMA in contralateral eye</td>
</tr>
<tr>
<td>Stage 1 macular hole</td>
<td>VMT</td>
</tr>
<tr>
<td>Stage 2 macular hole</td>
<td>FTMH – small or medium</td>
</tr>
<tr>
<td>Stage 3 macular hole</td>
<td>FTMH – medium or large</td>
</tr>
<tr>
<td>Stage 4 macular hole</td>
<td>FTMH – VMA release, small, medium, large</td>
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</tbody>
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Vitreomacular Adhesion (VMA) Associated with VMI Disease

- Epiretinal Membrane (ERM)
- Macular Schisis
- Macular Hole
- Lamellar Macular Hole
- Epiretinal Membrane (ERM)

VMA (rarely pathologic)
- 33% incidence

VMT (ALWAYS pathologic)
- 25% incidence

= Rare Secondary Paths to Macular Hole
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Summary

- **VMA** = stage of PVD progression
  - Focal vs broad
  - Isolated vs concurrent
- Abnormalities result in persistence of adhesion with traction = **VMT**
  - Focal vs broad
  - Isolated vs concurrent
VMI Diseases

Summary

• **VMT** can lead to:
  – Severe retinal anatomic abnormalities
  – FTMH
    • Small, medium, large
    • VMA - present or absent
    • Primary vs secondary
  – ERM
  – LMH
  – Macular Schisis