OCT Profiles of Vitreomacular Interface Pathologies

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Purpose

To help us understand:
• Clinical appearance (biomicroscopy)
• OCT characteristic profiles
• The mechanism of pathogenesis

Of different Vitreomacular pathologies so we can make a more accurate differential diagnosis and decide whether surgery is desirable and beneficial

Full Thickness Macular Holes

Definition

• Full-thickness depletion of neural retinal tissue in the centre of the macula (Yanoff: Ophthalmology 2nd Ed., 2004)
• First described by Knapp with respect to trauma (Knapp H. Ueber isolirte zerreissungen der aderhaut in folge von traumen auf dem augapfel. Arch Augenheilkd. 1869;1:6–29)
• Term first used by Ogilvie (Ogilvie FM. On one of the results of concussive injuries of the eye ("holes" at the macula). Trans Ophthalmol Soc U K. 1900;20:202–29)

Macular Hole Pathogenesis

• Donald Gass:
  – First to describe the process of macular hole formation based on clinical appearances (biomicroscopy)
  – Concept of tangential traction of the vitreous cortex
  – Retinal detachment at foveola
  – In 1988, published Gass’ classification/staging of idiopathic macular holes
Gass Staging
Idiopathic Macular Holes

Stage 1 holes ("Impending Holes")

Stage 1a
• Yellow spot in fovea

Stage 1b
• Yellow ring in fovea

Gass Staging
Idiopathic Macular Holes

Stage 2 holes
• Full-thickness foveal defect
  >400 µm in diameter
• Variable shape
• Overlying operculum may be seen

Gass Staging
Idiopathic Macular Holes

Stage 3 holes
• Full-thickness foveal defect
  >400 µm in diameter
• Round in shape
• Edge may be serrated, with striae radiating out from fovea
• Often accompanied by a surrounding cuff of subretinal fluid
• Overlying operculum may be seen
• No PVD

Gass Staging
Idiopathic Macular Holes

Stage 4 holes
• Similar to Stage 3 holes
• "Punched-out" appearance
• Complete PVD
• Weiss ring (=posterior vitreous detachment) often visible

OCT-based Classification of Idiopathic Macular Holes

• Stage 1 (1a, 1b)
• Stage 2 (2a, 2b)
• Stage 3
• Stage 4

OCT profile
Idiopathic Macular Holes

Stage 1a
• Partial-thickness intraretinal pseudocyst

Stage 1b
• Pseudocyst enlarges and extends to the outer retina, resulting in full-thickness pseudocyst, but roof still intact
Idiopathic Macular Holes

Stage 2 Holes
- Full-thickness defect caused by unroofing of the intraretinal pseudocyst brought on by vitreomacular traction
- Opening of the hole <400 µm in diameter

Stage 2a: Posterior hyaloid still attached to roof of pseudocyst
Stage 2b: Posterior hyaloid has torn off the roof of pseudocyst, resulting in an operculum seen in front of the hole

Stage 2a
Stage 2b

Stage 3
- Full-thickness hole >400 µm in min diameter
- Thickened surrounding retina and intraretinal cystoid spaces commonly seen
- Overlying operculum may be visible
- Perifoveal and prefoveal hyaloid detachment from retina

Stage 4
- Stage 3 holes with complete posterior hyaloid detachment from retina
- Posterior hyaloid often not visible on OCT as it lies too anterior


Vitreomacular Adhesion (VMA)
- Definition:
  - Remaining Vitreomacular attachment with no change in foveal contour
- Size of attachment area:
  - focal (<1500µm)
  - broad (>1500 µm)

Vitreomacular Traction (VMT)
- Definition:
  - Remaining vitreomacular attachment accompanied by anatomic foveal distortion
- Size of attachment area:
  - focal (<1500µm)
  - broad (>1500 µm)
**FTMH New Classification System**

- **Size of the hole**
  - VMT = present or absent
  - Primary versus secondary

- **Note:** no stages

**FTMH Classification – Size**

- **Small** = <250 μm
- **Medium** = >250 μm - < 400 μm
- **Large** = >400 μm

**Macular holes – Old Versus New**

<table>
<thead>
<tr>
<th>Old (based on Gass)</th>
<th>New (Intl Classification)</th>
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<tr>
<td>Stage 0</td>
<td>VMA</td>
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<tr>
<td>Stage 1: Impending macular hole</td>
<td>VMT</td>
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<tr>
<td>Stage 2: small hole</td>
<td>Small or medium FTMH with VMT</td>
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<td>Stage 3: large hole</td>
<td>Medium or large FTMH with VMT</td>
</tr>
<tr>
<td>Stage 4: FTMH with PVD</td>
<td>Small or medium or large FTMH without VMT</td>
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</tbody>
</table>

**Lamellar Macular Holes**

- Clinical Appearance
  - “Partial-thickness” holes
  - Described by Gass in 1975 as abortive process of FTMH due to drying of CME
  - Depletion of neural retinal tissue at the macula center (fovea) but NOT involving the full thickness of the retina
  - Clinically, appears as a round/oval reddish lesion in the macula center (similar to pseudoholes)

**OCT profile of LMHs**

- Irregular thinning of the central fovea (CFT<100µm)
- Absence of a full-thickness foveal defect
- Intact photoreceptors on foveal base
- Normal or moderately increased perifoveal retinal thickness


**Other features of LMHs**

- ERM present 62% - 89%
- PVD 53%
- Pseudo operculum 24%


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**Mechanism of LMH formation**

**PVD related:**
- Aborted process of FTMH formation
- Avulsion of the roof of a foveal cyst

**ERM related**
- Progressive contraction of perifoveal ERM

LMH “Stable”?  
LMH “Dynamic”?  

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**Pathogenesis of LMH**

**PVD related**

- Focal A-P vitreofoveal traction +
- Inner pseudocyst +/-
- Foveolar detachment

LMH  
FTMH

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**Pathogenesis of LMH**

**ERM related**

- ERM → contraction → splitting + enlargement of LMH
- Unclear role of posterior hyaloid
- Vitreoschisis theory

“Dynamic” LMH

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**Lamellar Macular hole**

**Natural history**

- 41 pts with LMHs
- Mean f/u: 37 months (24-54)

- LMH diameter, especially in the presence of ERM
- Mean foveal thickness
- BCVA: stable (78%) and deteriorated (22%)

Natural History

- Spontaneous closure of LMH, following complete PVD
- Increase in mean foveal thickness
- 2 pts


Surgical intervention

- 34 pts
- Mean f/u: 18 months (6-24)
- All had ERM

- No change in BCVA
- No change in foveal thickness
- 2 LMHs progressed into FTMHs (5.8%)


Surgical intervention

- 16 eyes
- Anatomical improvement: 62% (10/16)
- No change in BCVA
- 2 eyes developed FTMH postoperatively (13%)


Surgical intervention

- 44 pts with LMH
- All had ERM
- BCVA improved by >1 ETDRS line(s): 89% and >2 ETDRS lines: 58%


Surgical intervention

- 32 pts
- 20 had ERM

- In pts with ERM:
  - BCVA improved in 17/20 (85%) by 2.6 Snellen lines

Surgical intervention

- 27 pts with LMH and central visual loss
  - BCVA improved in 25/27 pts (93%)
  - Mean Snellen VA Improved by 3.2 lines

Vitrectomy for a symptomatic lamellar macular hole
Garretson BR et al Ophthalmology 2008 May;115(5):884-886

Take home message:

- OCT based diagnosis for LMHs
- ΔΔ LMH vs PMH sometimes tricky
- Common pathophysiology with “dynamic” LMH (ERM) ??
- Observation for stable LMHs
- Sx for symptomatic patients ??

Macular Pseudoholes

- Macular lesion that has the appearance of a FTMH
- BUT does not have a loss of foveal tissue
- Attributed to the centripetal contraction of a surrounding epiretinal membrane (ERM)


OCT Profile of Macular Pseudoholes

- Central foveal thickness normal or slightly increased
- Thickened foveal edges
- Verticalization of foveal slope
  - foveal pit acquires a steepened and cylindrical appearance making it appear like a punched-out FTMH clinically
- Smaller diameter than lamellar holes
- Epiretinal membrane invariably co-exists
  - ERM contraction is believed to exert centripetal force on the underlying retina

Thank you