COMPLICATIONS & DISADVANTAGES OF ILM PEELING

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The Complications & disadvantages of ILM peeling

A. Chromophore Toxicity.

- Retinal toxicity can occur secondary to the specific dye used during chromovitrectomy.

1. **Indocyanine green (ICG)**,
   i. Introduced in 2000, and is a chromophore that stains the ILM secondary to its affinity for laminin and collagen type IV.
   ii. Several authors have reported side effects observed with ICG use,
      - the most common being visual field defects,
      - reduced retinal nerve fiber layer thickness on OCT, and
      - RPE or ganglion cell changes that manifest as abnormalities on multifocal electroretinography (mfERG), light and transmission electron microscopies, and reduced enzymatic activity.
   iii. The mechanism of injury is unclear, but the adverse effects could be related to the dose of the dye, its osmolarity, or the photooxidative qualities causing cellular damage.

2. Trypan blue (TB)
   i. It is a dye that stains damaged cell membranes often used in epiretinal membrane removal in addition to ILM peeling.
   ii. The formulations used in vitreoretinal surgery are low concentrations, but experimental studies have shown TB induces neurotoxic effects on retinal ganglion cells in a dose- and time-dependent manner.

3. Triamcinolone acetonide (TA)
   i. It is used to identify the posterior vitreous cortex, epiretinal membranes, and the ILM during vitrectomy.
   ii. Conflicting evidence makes it difficult to definitively say if TA is toxic to the retina, though there are published reports of its use producing similar adverse effects to ICG.
   iii. Crystal deposition secondary to TA, which aids in ILM removal, has been proposed to delay the healing process and affect macular hole closure

4. **Brilliant blue G (BBG)**
   i. It selectively binds to and stains ILM similarly to ICG, optimizing ILM peeling.
   ii. Historically found to have good clinical outcomes without evidence of toxicity on mfERG, it has widely been accepted as a good alternative dye, though its safety profile is still a matter of controversy

B. Damage to the Muller Cell.

1. Given the close proximity of the ILM to the inner retina and its interdigitation with Muller cell footplates, it is not surprising to find retinal tissue and Muller cell debris on removed ILM specimens.
2. Though there are variable amounts and sizes of such debris found on the ILM depending on the underlying disease process, one might reasonably wonder whether loss of inner retinal elements interferes with normal retinal function.
3. Muller cells are specialized cells that contribute to retinal homeostasis and they are an integral component of the ILM, contributing to formation of the b-wave on the electroretinogram (ERG).
4. Implicit time (time to-peak of the b-wave), which is a more sensitive measure of retinal damage than amplitude, was prolonged in cases with ILM peeling indicating Muller cell damage and possibly subtle macular dysfunction.

C. Paracentral Retinal Holes.

1. In a case series from 2006, Steven et al. reported the formation of paracentral retinal holes following seemingly a traumatic ILM removal, observed with ICG, TB, and TA and when no adjuvant dye was used.
2. They suggested that this postoperative finding might be a consequence of Muller cell damage causing weakening of the glial structures of the retina and ultimately hole formation.
3. Muller cells remove metabolic waste products from retinal neurons; their removal in the process of ILM peeling may induce glial apoptosis and resultant retinal dysfunction.
4. As these secondary paracentral holes always developed in the area of ILM removal, the authors discuss possibly limiting the area of retina that is peeled.

D. Paracentral microscotomas

1. Results of combined scanning laser ophthalmoscope (SLO) microperimetry and spectral domain OCT and demonstrated a significantly lower mean retinal sensitivity and more frequent postoperative microscotomas in eyes that underwent ILM removal.

2. The reduced retinal sensitivity & development of microscotomas may be secondary to direct damage to Muller cells.

E. Dissociated Optic Nerve Fiber Layer (DONFL).

1. DONFL appearance is described as arcuate retinal striae along the optic nerve fibers in the macular region, slightly darker than the surrounding retina.
2. DONFL appearance may be secondary to mere shifting of optic nerve fibers, rather than deterioration, resulting from loss of Muller cell support or postoperative regenerative processes of Muller cells or astrocytes.

F. Phototoxic Damage.

1. Phototoxic damage to the retina can occur because of photothermal, photomechanical, or photochemical mechanisms.
2. Photothermal damage results from prolonged exposure of the retina to a light source.
3. Photomechanical retinal damage is a possibility if there is physical contact between the light probe and the retina.
4. Photochemical damage results when the visible light excites endogenous or exogenous chromophores.
5. The endogenous chromophores excitable by visible light wavelengths are the photoreceptor pigments, as well as the melanin and lipofuscin of the RPE.
6. ICG is an example of an exogenous chromophore excitable by visible light.
7. Chromophore excitation produces reactive oxygen species, which cause lipid peroxidation and ultimately destroy cell membranes