Trauma

steve charles
Pathobiology of Trauma

• Hypocellular Vitreous Collagen Contraction (formerly called gel contraction)
  • Poor Names:
    • Vitreous Bands & Vitreous Membranes (always along vitreous surface or path of IOFB or double perf object)
    • Vitreous Organization (immobility due to fibrosis) Should Not Be Confused With Opacification (blood)
  • Repair (healing) of All Damaged Layers
    • Retina, Sclera, Choroid, RPE
    • Excessive Repair Causes Fibrovascular PVR (keloid like)
    • Very Rarely “Ingrowth” of Extra-Ocular Tissue
Pathobiology of Cyclitic Membranes

- Hypocellular Scar/Repair Tissue
  - Substrates (also called scaffold”)
    - Lens, IOL, Iris, Vitreous, Blood Clot, Fibrin
  - Cell Sources
    - Sclera, Episclera, Tenon’s, RPE, Mueller Cells, Choroid, Iris, Ciliary Body, Lens Epithelial Cells, Blood (inflammatory cells)
- Usually Not Tissue Ingrowth
- Not Caused by Hypotony
Significance of Hypotony

- Cyclitic Membranes Cause Phthisis (ocular contraction on plane thru ciliary body)
- Hypotony Does Not Cause Phthisis
- Phthisis Does Not Always Result In Hypotony
- Can Be From Non-Apparent Wound Leak in Recent Trauma Cases
- Often Caused By Ciliary Body Destruction and/or Epiciliary Tissue, Not Detachment of Ciliary Body
When to Operate

- Operate When Hypocellular Vitreous Collagen Contraction First Detected
  - Determine By Assessing Vitreous Mobility With Indirect Ophthalmoscope, Slit Lamp, and/or B-Scan Ultrasound During Saccades (don’t ask patient to fixate with the other eye during ultrasound exam, ask them to look around)
  - Number of Days Less Relevant (7-14 days usually optimal)
- IOP Is Irrelevant
- ERG Useless (total RD = non-recordable ERG, scleral wound also significantly decreases ERG)
Timing of Intervention

- **Immediate**
  - Ferrous or Copper Foreign Body, Esp. If Near Macula
  - Plant, Animal or Human Biologic Materials, Any Risk of Bacterial or Fungal Contamination

- **Delayed**
  - Inability to Determine Lens Clarity Because of Hyphema (if no endophthalmitis risk)
  - Plastic, Glass, Pellet, Inert (if no endophthalmitis risk)
Problems With Immediate Vitrectomy for Penetrating Trauma

- Arterial Bleeding
- Wound Leaks
- Choroidals & Suprachoroidal Hemorrhage
- Poor View
  - Corneal Striae & Edema
  - Miosis From Hypotony and Iris Trauma
- Absence of Posterior Vitreous Detachment in Young Patients That Typically Suffer Trauma Increases Difficulty of Surgery and Therefore Incidence of Iatrogenic Retinal Breaks & Detachment
Wound Repair Sequence

Close, Then Explore, Repeat

8-0 Nylon in Sclera, 10-0 in Cornea

No Cellulose Sponges to Wounds

No Cryo to Wounds

Do Not Explore Entire Wound And Then Begin Repair

Do Not Use Absorbable Sutures

Cellulose Sponges Cause Acute Vitreoretinal Traction

Cryo to Wounds Causes Excessive Scarring/Repair
Argument Against Exploring Posterior to Equator

• The Risk of Fibrovascular Tissue Ingrowth Is Greatly Exaggerated
• Exploration Posterior to the Equator Often Causes Vitreous and Retinal Prolapse Which Create Much Higher Risk Than Fibrovascular Ingrowth
• Placing Traction Sutures Under the Rectus Muscles Can Result in Muscle Hooks Penetrating the Eye, Thinnest Sclera Is Under Muscle Insertions, Muscle Insertion is Most Common Rupture Site
• 360° Peritomy Increases Risk of Symblepharon, Strabismus, Post-Op Swelling and Discomfort
• Much Longer Operating Times
Role of Viscoelastics in Wound Repair

• Viscoelastics are Excellent Tool for Repositioning Iris, Retina, Choroid, Ciliary Body
• Excellent for Maintaining Anterior Chamber While Suturing
  • Protect Lens, Iris, Endothelium
  • Less Hypotony
  • Less Astigmatism
  • Confine Bleeding
• Viscodilation of Pupil
# Tradeoffs in Wound Repair

<table>
<thead>
<tr>
<th>Do's</th>
<th>Don'ts</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Close Exposed Wound, Then Explore</td>
<td>• Put Pressure on Eye by Exploring or Closing Posterior Wounds, Trapping Muscles or Doing 360° Peritomy</td>
</tr>
<tr>
<td>• Trim Vitreous Flush With Inner Wound Margin With Cutter or Vannas Scissors &amp; BSS Irrigation</td>
<td>• Use Cellulose Sponge to Test For or Remove Vitreous</td>
</tr>
<tr>
<td>• Monofilament Nylon</td>
<td>• Use Absorbable Sutures</td>
</tr>
<tr>
<td>• Running-Interrupted</td>
<td></td>
</tr>
<tr>
<td>• 10-0 in Cornea</td>
<td></td>
</tr>
<tr>
<td>• 9-0 at Limbus</td>
<td></td>
</tr>
<tr>
<td>• 8-0 in Sclera</td>
<td></td>
</tr>
</tbody>
</table>
Common Mistakes in Trauma Management

- Focus on Plastic (cosmetic) Instead of Ocular (vision) Issues
- Phaco & IOL in Acute Setting, Wait Until Inflammation Less
- Timing Mistakes
  - Too Early (no PVD, bleeding, miosis, corneal folds/edema, wound leaks)
  - Delay Beyond Two Weeks Increases Fibrovascular PVR Risk
- Deemed Inoperable Because of Low Pressure (hypotony phobia)
- Laser or Cryo to Exit Wounds or IOFB Retinal Contact Site Causes Scarring and Is Unnecessary Unless Definite Retinal Break
- Excessive Exploration Causing Vitreous and Retinal Prolapse
- Cellulose Sponge Vitrectomy Causes Vitreoretinal Traction, Breaks, RD
- Cryopexy to Wounds Causes Excessive Repair/Scarring
Common Mistakes in Trauma Management cont.

- Temporary Keratoprosthesis
- Iris Retractors (use viscodilation if possible)
- Scleral Buckles
Temporary Keratoprosthesis Issues

• Poor Access To Peripheral Tissue:
  • Posterior Iris Surface
  • Ciliary Body Surface
  • Pars Plana, Vitreous Base, & Peripheral Retina
• Prolongs Operating Time
• Cannot Remove Large IOFB Through Pars Plana
• Reusing Patient’s Damaged Cornea Results in No Post-Operative View and Additional Surgery
• Open Sky Vitrectomy with Excellent Retrobulbar Block or General Anesthesia with Neuromuscular Blockade is Crucial
Temporary Keratoprosthesis vs. Open Sky

**Open Sky**
- Better Access to Ciliary Body, Peripheral Retina
- Safer Removal of Large IOFB
- Facilitates Bimanual Surgery with Optimal Tool Orientation

**Temporary EKP**
- Replaced Cornea Often Later Decompensates
- Poor Post-Op View
- Much Longer Operating Times
Inappropriate Phako & IOL In Trauma Setting

- Two Compartment Eye Causes:
  - Increased PVR From Retained Cells & Cytokines
  - Increased Fibrin Syndrome
  - Very Limited Posterior Segment Penetration For Topical Meds
  - Slower Clearing of Vitreous Hemorrhage
  - Substrate for Cyclitic Membrane & Anterior PVR
- Poor Fixation of IOL Because of Angle, Iris, and Capsule Damage
- Intraoperative Vitreoretinal Traction & Posterior Dislocation of Lens Material Thru Traumatic Capsular Defects During Phaco
Iris Retractor Issues

- Iris Trauma from Retractor Causes More Inflammation
- More PAS & Iris Damage
- Viscodilation is Usually a Better Solution
- Contact-Based Wide Angle Visualization Usually Solves Miosis Issue
Disadvantages of Encircling Buckles/ Bands

- Delayed Scleral Intrusion (young males)
- Strabismus
- Ptosis
- Substantial, Unpredictable Induced Myopia
- More Pain
- Pressure on Eye & Wound Disruption During Surgery Due to Placement of Sutures Under Extraocular Muscles
- Longer Operating Times
Endophthalmitis Prevention

• Avoid Delaying Vitrectomy
• Vitrectomy Advantages
  • Reduction of Bacterial & Fungal Load; Especially With Plant Material, Human & Animal Bites, & Contaminated IOFB’s
  • Removal of Bacterial Endotoxins
• Intraocular & Peri-Bulbar Antibiotics
Negative Effects of Cryo or Laser to Wounds, IOFB Contact Sites

• Retinopexy Causes Excessive Tissue Repair/Scarring/PVR
• Retinopexy Is Often Unnecessary Because Trauma Usually Causes Retina-RPE Bonding
• Retinopexy Before IOFB Removal Immediately Reduces Tensile Strength of Retina & Increases Risk of Retinal Break During IOFB Extraction
Entry Wound Closed w/ Running 8-0 Nylon

Remove Cone To Prevent Transvitreal Proliferation

Leave Pre-Wound Vitreous

No Sutures To Exit Wound Unless Leak

B. Wood
Rationale for Vitrectomy with IOFB’s

- Better Visualization
- Eliminates Need for Magnet Which Can Cause Rotation of Sharp Edges Into Retina or Lens
- Removal of Substrate for Hypocellular Vitreous Collagen Contraction
- Reduction of Bacterial & Fungal Burden
- Removal of Toxic Materials (ferrous, copper)
- Concomitant Repair of Retinal Breaks & Detachment
- Lensectomy & Complete Capsulectomy for Traumatic Cataract
Machemer Parel
Diamond Coated Forceps
Enlarge Sclerotomy After IOFB Pickup to Avoid Soft eye
Very Large IOFB Should Be Removed Through Limbus, Not Pars Plana
Incise Capsule to Remove Late IOFB
Enlarge Initial Capsule Opening with Scissors to Remove Late IOFB
Extract IOFB from Capsule
Remove Subretinal IOFB Using Retinotomy
Not Trans-Scleral/Trans-Choroidal to Avoid
Choroidal Hemorrhage and Retinal Prolapse
Two Forceps Technique for Wire IOFB
To Enable Extraction on Long Axis of IOFB for Smaller Sclerotomy
Advantages of Silicone Oil in Trauma

Retinopexy Avoidance

• Excessive Retinopexy Causes PVR/Scarring
• Interfacial Surface Tension of Silicone Oil Enables Rhegmatogenous Confinement; Breaks Can Be Treated Later
• At least Two Weeks Before Oil Removal to Reduce Proliferation
  • Missed Breaks Due to Poor View & Blood
  • New Breaks 20 to PVR/Scarring
  • Necrotic Retina (blunt trauma & vascular occlusion)