Diabetic Surgery Tips and Tricks

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  – Acucela
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  – Genentech
  – Thrombogenics

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  – Advanced Cell Technology
  – Juvenile Diabetes Foundation

Pars Plana Vitrectomy

• Introduced in 1970 by Robert Machemer
  – nonclearing diabetic vitreous hemorrhage
    • duration 5 years
    • 2/200 preop

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    - duration 5 years
    - 2/200 preop → 20/50 postop

Expanding Indications

1977
- VH (70%)
- TRD (20%)
- TRD / RRD (10%)

1987
- VH (15%)
- TRD (40%)
- TRD / RRD (35%)
  - other (10%)
    - severe FVP
    - VH / rubeosis
    - ghost cell
    - premacular heme

Today
- VH
- TRD
- TRD / RRD
- other
  - severe FVP
  - VH / rubeosis
  - ghost cell
  - premacular heme
  - DME taut hyaloid
  - DME not taut
  - vitreopapillary traction
  - TRD threatening
Goals of Diabetic Vitrectomy

- remove all anteroposterior and tangential traction
  - avoid / minimize iatrogenic retinal breaks
- maintain hemostasis
- prevent recurrence

Diabetic Vitrectomy

- How do we maintain hemostasis?
  - prevention of intraoperative hemorrhage
    - adequate visualization
    - preoperative bevacizumab
  - control bleeding
    - VGF
    - diathermy (tissue manipulator with diathermy)
  - prevention of postoperative hemorrhage
    - thorough endolaser

Improved Visualization

- high magnification contact lens
  - essential for membrane peeling
  - essential for minimizing hemorrhage
    - careful dissection is the best method of preventing hemorrhage

Hemostasis

- preoperative bevacizumab
Bevacizumab

- regression of NV
  - injection before vitrectomy to reduce bleeding
    - caution: contraction of fibrous tissue

Hemostasis

- gas-forced infusion
  - IOP control
- intraocular pressure sensor

Hemostasis

- tissue manipulator (diathermy)

Postoperative Hemorrhage

- thorough endolaser prevents postoperative hemorrhage
  - articulating / curved endolaser
    - enables laser to ora
Diabetic Vitrectomy

- How do we relieve all traction?
  - elevate and excise posterior hyaloid
    - know where the hyaloid is attached and detached
  - remove all membranes
    - eliminate all vitreoretinal adhesions
    - avoid unrelieved traction
  - scleral buckle / retinectomy
    - if unrelieved traction despite attempted membrane removal

Vitreoretinal Attachments

total PVD
  - only indication for surgery is nonclearing vitreous hemorrhage

focal V-R attachments
  - point attachments at disc or along arcades
  - +/- TRD/RRD
Vitreoretinal Attachments

**focal V-R attachments**
- point attachments at disc or along arcades
- +/- TRD/RRD

Vitreoretinal Attachments

**broad V-R attachments**
- larger attachments at disc or along arcades
- +/- TRD/RRD

Vitreoretinal Attachments

**broad V-R attachments**
- vitreous attached at disc, macula, and arcades only
Vitreoretinal Attachments

- Vitreous attached at disc, macula, and arcades only

Vitreoretinal Attachments

- Vitreous attached from arcades to periphery
  - Low lying vitreomacular separation
  - +/- premacular subhyaloid heme

Vitreoretinal Attachments

- Vitreous attached from arcades to periphery

Vitreoretinal Attachments

- Vitreous attached from arcades to periphery
Vitreoretinal Attachments

- Vitreous attached everywhere
- No PVD

Diabetic Vitrectomy

- How do we relieve all traction?
  - Remove all membranes
    - Eliminate VR adhesions
    - Avoid unrelied traction
  - Bimanual dissection
    - Segmentation
    - Delamination

Vitreoretinal Attachments

- Extent of vitreous attachment in eyes undergoing diabetic vitrectomy is predictive of
  - Reproliferation
  - Visual acuity
  - Total PVD
  - Focal vitreoretinal attachments
  - Broad vitreoretinal attachments
  - Vitreous attached at macula and arcades only
  - Vitreous attached from arcades to periphery
  - No PVD
**Surgical Approach**

- bimanual dissection
  - segmentation & delamination
- tissue manipulator
- MPC scissors

**Bimanual Dissection**

- segmentation
  - membranes divided into separate islands

**Bimanual Dissection**

- delamination
  - membranes removed from retinal surface

**Vitrectomy Probe**

- cutting port 50% closer to tip (25 & 23 gauge)
  - enables closer membrane dissection
**Vitrectomy Probe**

- segmentation and delamination
  - in most cases
    - vitrectomy probe (unimanual)
  - in complex cases
    - scissors (unimanual)
    - scissors + lighted pick (bimanual)
    - scissors + forceps (bimanual, with chandelier)

**Illuminated Pick**

- illuminated membrane pick

**Vitreoretinal Traction**

- elevate and excise posterior hyaloid
- eliminate all vitreoretinal adhesions
  - complete membrane removal
- consider scleral buckle for peripheral traction
- consider retinectomy for unrelieved traction

**Improved Visualization**

- preservative free triamcinolone
Improved Visualization

Diabetic Vitrectomy

• How do we relieve all traction?
  – retinectomy
    • if unrelieved traction despite attempted membrane removal
  – incidence in PDR cases
    • primary vitrectomy: retinectomy performed in 5%
      • no effect on outcome
    • reoperation vitrectomy: performed in 25%
      • strongly correlated with outcome

Retinectomy

• incidence in PDR cases
  – primary vitrectomy: retinectomy performed in 5%
    • no effect on outcome
  – reoperation vitrectomy: performed in 25%
    • strongly correlated with outcome

Retinectomy - PDR

• focal posterior retinectomy
  • fibrovascular plaque with adjacent break
Retinectomy - PDR

- large peripheral retinectomy
  - unrelieved peripheral traction despite extensive membrane peeling

preop  postop

Retinectomy - Conclusions

- Removal of fibrotic, contracted retina
  - when periretinal traction and retinal foreshortening cannot be relieved by epiretinal membrane dissection and scleral buckling
- Inferior 180 degree most common
- Lensectomy helps prevent hypotony and recurrent traction
- Scleral buckle supports retinectomy edge
- Retained subretinal perfluorocarbon can be minimized
- Reproliferation an unsolved problem

Diabetic Vitrectomy

- What is the role of lensectomy?
  - does lensectomy (and resultant aphakia) result in more rubeosis?

Lensectomy

- pars plana lensectomy associated with less postoperative rubeosis
Lensectomy

- Pars plana lensectomy associated with less postoperative rubeosis
  - related to more complete peripheral vitrectomy and endolaser

Lensectomy

- Pars plana lensectomy associated with less postoperative rubeosis
  - related to more complete peripheral vitrectomy and endolaser

Lensectomy

- Enables more complete vitrectomy
- Enables access to anterior proliferations
- Enables release of anterior retinal and ciliary body traction

Lensectomy

- Anterior capsule preserved
  - Future sulcus PCIOL?
Lensectomy

- anterior capsule preserved
  - future sulcus PCIOL?

**FANTASY!!!**

**REALITY!!!**

Opacifies

**REALITY!!!**

Opacifies, wrinkles
Lensectomy

• anterior capsule preserved

REALITY!!!

- opacifies
- wrinkles
- iris adhesions

oil in AC
closed PI

closed PI

hypotony
Lensectomy

- anterior capsule preserved

REALITY!!!

opacifies
wrinkles
iris adhesions
hypotony
anterior RD

oil in AC
closed PI

Lensectomy

- anterior capsule preserved

REALITY!!!

opacifies
wrinkles
iris adhesions
hypotony
anterior RD
prephthisical

oil in AC
closed PI

Lensectomy

- same patient, fellow eye

- aphakia

Lensectomy

- anterior capsule preserved

REALITY!!!
**Lensectomy**

- anterior capsule preserved  

**REALITY!!!**

- opacifies
- iris adhesions 360

**pupillary block**

- closed PI
Lensectomy
• anterior capsule preserved

REALITY!!!

- opacifies
- iris adhesions 360
- pupillary block
- closed PI
- iris bombe

Lensectomy
• anterior capsule preserved

REALITY!!!

- opacifies
- iris adhesions 360
- hypotony
- pupillary block
- closed PI
- iris bombe

Lensectomy
• anterior capsule preserved

REALITY!!!

- opacifies
- iris adhesions 360
- hypotony
- anterior RD
- pupillary block
- closed PI
- iris bombe

Lensectomy
• same patient, postop

- capsule removed
- epiciliary membranectomy
- retinectomy

- IOP improved
- oil at pupil
- retina attached
Lensectomy

- **peripheral** capsule preserved
  - future sulcus PCIOL?

REALITY!!!

iris adhesions

macular edema

REALITY!!!
Lensectomy

• **peripheral** capsule preserved  REALITY!!
  - iris adhesions
  - macular edema

macular edema resolved after capsule removal

Lensectomy

• Lensectomy?
  - aphakia correlated with normal IOP
  - phakia / pseudophakia associated with postoperative hypotony


Goals of Diabetic Vitrectomy

• remove *all* anteroposterior and tangential traction

Influence of Postoperative Lens Status on Intraocular Pressure in Proliferative Vitreoretinopathy

Diabetic Vitrectomy

- How do we maintain hemostasis?
  - prevention of intraoperative hemorrhage
    - adequate visualization
    - preoperative bevacizumab
  - control bleeding
    - VGF1
    - diathermy (tissue manipulator with diathermy)
  - prevention of postoperative hemorrhage
    - thorough endolaser

Retinectomy in PDR

- removal of fibrotic, contracted retina
  - when retinal traction and foreshortening cannot be relieved by epiretinal membrane dissection
  - in PVR cases, inferior 180 degree is most common
  - in PDR cases
    - focal posterior retinectomy
    - large peripheral retinectomy

Lensectomy in PDR

- enables more complete vitrectomy
- in severe cases with TRD involving macula
  - preserving anterior capsule or peripheral capsule
    - multiple anterior and posterior segment complications, including hypotony
  - PCIOL rarely implanted
    - assess risk-benefit ratio

Vitreoretinal Attachments

- extent of vitreous attachment in eyes undergoing diabetic vitrectomy is predictive of
  - total PVD
  - focal vitreoretinal attachments
  - broad vitreoretinal attachments
  - vitreous attached at macula and arcades only
  - vitreous attached from arcades to periphery
  - no PVD
  - visual acuity
Lensctomy - Summary

- macula-off RD with PVR (or macula-off TRD in PDR)
  - anterior capsule or peripheral capsule was preserved
  - PCIOL later implanted
  - IOL implantation resulted in substantial improvement in vision

- $100 reward

Diabetic Vitrectomy

- prevent recurrence / reproliferation
  - thorough endolaser

Micro-incision Vitrectomy

- Introduced in 2002 (Fujii, et al)
  - alternative to traditional 20-gauge surgery
  - select vitreoretinal cases

Micro-incision Vitrectomy

- transconjunctival
  - eliminates need for conjunctival peritomy
- sutureless
  - self sealing sclerotomies
  - no conjunctival sutures
Cannula / Trocar Insertion

Micro-incision Vitrectomy

- more rapid visual recovery
- decreased surgical time
- less conjunctival trauma
- reduced patient discomfort

Vitreous Cutting

- high speed cutting
  - 5000 cuts / min
- 3D technology
  - improved surgeon control

Improved Illumination

- xenon
  - much brighter
  - closer to white light than halogen or metal halide
**Improved Visualization**

- non-contact, wide-angle, panoramic viewing
  - BIOM

**Adjuvants**

- ICG
- Trypan Blue
- Triamcinolone

**Vitreoretinal Attachments**

- staging / grading system that describes the extent of vitreoretinal attachments
  - in case selection for small incision surgery
  - in assessing the efficacy of compounds that cleave vitreoretinal junction
  - to predict visual and anatomic outcome
Preoperative Assessment

- vitreoretinal attachments are assessed and categorized (preoperatively or intraoperatively)

0. total PVD
1. focal vitreoretinal attachments
2. broad vitreoretinal attachments
3. vitreous attached at macula and arcades only
4. vitreous attached from arcades to periphery
5. no PVD

Vitreoretinal Attachments

0. total PVD

- only indication for surgery is nonclearing vitreous hemorrhage

Vitreoretinal Attachments

1. focal V-R attachments

- point attachments at disc or along arcades
- +/- TRD

Vitreoretinal Attachments

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- point attachments at disc or along arcades
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Vitreoretinal Attachments

1. focal V-R attachments
   - point attachments at disc or along arcades
   - +/- TRD

2. broad V-R attachments
   - larger attachments at disc or along arcades
   - +/- TRD

3. vitreous attached at disc, macula, and arcades only
Vitreoretinal Attachments

3. vitreous attached at disc, macula, and arcades only

Vitreoretinal Attachments

4. vitreous attached from arcades to periphery
   - low lying vitreomacular separation
   - +/- premacular subhyaloid heme

Vitreoretinal Attachments

4. vitreous attached from arcades to periphery
Vitreoretinal Attachments

5. vitreous attached everywhere
   - no PVD

Vitreoretinal Attachments

- purpose: to attempt to correlate these findings with visual and anatomic outcome
  - 200 consecutive primary diabetic vitrectomies
    - vitreous hemorrhage (VH)
    - traction retinal detachment (TRD)
    - combined traction/rhegmatogenous detachment (TRD/RRD)

Vitreoretinal Attachments

- vitreoretinal attachments were assessed and categorized
  0. total PVD
  1. focal vitreoretinal attachments
  2. broad vitreoretinal attachments
  3. vitreous attached at macula and arcades only
  4. vitreous attached from arcades to periphery
  5. no PVD

increasing area of vitreoretinal attachment
Vitreoretinal Attachments

- intraoperative findings were correlated with:
  - reeproliferation / reoperation
  - final visual acuity

Reproliferation - Reoperation

Type 1

pre-op
20/100

post-op
20/36
Type 2

pre-op CF

post-op 20/60

Type 3

pre-op HM

post-op 20/400

Type 4

pre-op 20/400

post-op 20/400

Type 5

pre-op CF

post-op CF
### Visual Acuity

<table>
<thead>
<tr>
<th></th>
<th>VH</th>
<th>TRD</th>
<th>TRD/RRD</th>
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<tbody>
<tr>
<td>0. total PVD</td>
<td>20/50</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1. focal V-R</td>
<td>20/50</td>
<td>20/80</td>
<td>20/40</td>
</tr>
<tr>
<td>2. broad V-R</td>
<td>20/50</td>
<td>20/100</td>
<td>20/100</td>
</tr>
<tr>
<td>3. mac-arcades</td>
<td>20/70</td>
<td>20/200</td>
<td>20/400</td>
</tr>
<tr>
<td>4. arc-periphery</td>
<td>20/60</td>
<td>20/100</td>
<td>20/400</td>
</tr>
<tr>
<td>5. no PVD</td>
<td>20/100*</td>
<td>20/400</td>
<td>CF*</td>
</tr>
</tbody>
</table>

### Reproliferation - Reoperation

<table>
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<th>VH</th>
<th>TRD</th>
<th>TRD/RRD</th>
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<tbody>
<tr>
<td>0. total PVD</td>
<td>0/19</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1. focal V-R</td>
<td>0/24</td>
<td>0/3</td>
<td>0/3</td>
</tr>
<tr>
<td>2. broad V-R</td>
<td>1/15</td>
<td>0/5</td>
<td>1/11</td>
</tr>
<tr>
<td>3. mac-arcades</td>
<td>0/3</td>
<td>1/5</td>
<td>0/5</td>
</tr>
<tr>
<td>4. arc-periphery</td>
<td>2/20</td>
<td>1/17</td>
<td>2/11</td>
</tr>
<tr>
<td>5. no PVD</td>
<td>1/16</td>
<td>4/19</td>
<td>4/24</td>
</tr>
</tbody>
</table>

### Reproliferation - Reoperation

<table>
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<tr>
<th></th>
<th>VH</th>
<th>TRD</th>
<th>TRD/RRD</th>
</tr>
</thead>
<tbody>
<tr>
<td>0. total PVD</td>
<td>0/19</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1. focal V-R</td>
<td>0/30</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2. broad V-R</td>
<td>2/31</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3. mac-arcades</td>
<td>1/13</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4. arc-periphery</td>
<td>5/48</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5. no PVD</td>
<td>9/59</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Conclusions

- extent of vitreous attachment in eyes undergoing diabetic vitrectomy may be predictive:
  - reproliferation
  - visual results
    0. total PVD
    1. focal vitreoretinal attachments
    2. broad vitreoretinal attachments
    3. vitreous attached at macula and arcades only
    4. vitreous attached from arcades to periphery
    5. no PVD

Conclusions

- eyes with extensive areas of vitreous attachment had higher rates of reproliferation requiring reoperation

Conclusions

- eyes with extensive areas of vitreous attachment had worse final visual outcome

Conclusions

- extent of vitreoretinal attachment may be useful:
  - as a staging / grading system
    - predicts visual and anatomic outcome
Conclusions

• while significant improvements in surgical techniques, instruments, and adjuvants have been made, surgery is not the answer
  – identification of risk factors for diabetes and diabetic retinopathy with emphasis on targeted screening and early treatment
  – new pharmacotherapies for prevention / treatment

Diabetic Vitrectomy

• control hemostasis
  – prevention of hemorrhage
    • adequate visualization, preoperative avastin
  – control bleeding
    • VGFI, diathermy / tissue manipulator

Diabetic Vitrectomy

• relieve all traction
  – technique of membrane removal
  – scleral buckle / retinectomy

• prevent recurrence / reproliferation
  – thorough endolaser

Visualization

• wide – angle viewing
  – contact
    • AVI
    • Volk
  – non-contact
    • BIOM
• iris hooks
Wide-Angle Viewing

- contact
  - AVI
  - Volk

Wide-Angle Viewing

- non-contact
  - BIOM

Visualization

- iris retractors

Hemostasis

- VGFI
- tissue manipulator (diathermy)
Techniques of Diabetic Membrane Removal

- segmentation
- delamination
- en bloc dissection
- combination of above techniques

Surgical Approach

remove central and peripheral vitreous

Bimanual Dissection

- dissect the posterior hyaloid and all associated fibrovascular membranes to the periphery
- begin in peripapillary region and proceed anteriorly

Instruments

- Vitrectomy Probe
- Membrane Peeling
  - Tissue manipulator
  - MPC Scissors
Membrane Peeling

- tissue manipulator
- MPC scissors

Membrane Peeling

- bimanual dissection
- segmentation
delamination

Tools

- Instruments
- Adjuncts
- Visualization
- Illumination
- Small Gauge Vitrectomy

Adjuncts

- Perfluorocarbon Liquids
- Intraocular Gases
- Silicone Oil
**Perfluorocarbon Liquid**
- Approved in 1990’s
  - used in 6% of diabetic vitrectomies
    - pre-existing or iatrogenic peripheral retinal break (in the absence of posterior break)

**Intraocular Gases**
- Widespread use 1990’s
  - used for vast majority of cases that have a retinal break

**Silicone Oil**
- Approved in 1990’s
  - used in cases with peripheral retinectomy (<5% cases)

**Vitreoretinal Attachments**
- staging / grading system that describes the extent of vitreoretinal attachments
  - in case selection for small incision surgery
  - in assessing the efficacy of compounds that cleave vitreoretinal junction
**Preoperative Assessment**

- vitreoretinal attachments are assessed and categorized (preoperatively or intraoperatively)
  0. total PVD
  1. focal vitreoretinal attachments
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  5. no PVD

**Prospective Study**

- purpose: to attempt to correlate these findings with visual and anatomic outcome
- 200 consecutive primary diabetic vitrectomies

**Methods**

- vitreoretinal attachments were assessed and categorized
  0. total PVD
  1. focal vitreoretinal attachments
  2. broad vitreoretinal attachments
  3. vitreous attached at macula and arcades only
  4. vitreous attached from arcades to periphery
  5. no PVD

**Retinectomy**

- fibrovascular plaques with adjacent breaks
- access to subretinal membranes
Retinectomy

- unrelieved peripheral traction despite scleral buckle placement

Diabetic Vitrectomy

- preoperative assessment
  - have a plan

- control hemostasis
  - prevention of hemorrhage
    - adequate visualization, preoperative avastin
  - control bleeding
    - VGF, diathermy / tissue manipulator

Diabetic Vitrectomy

- relieve all traction
  - technique of membrane removal
  - scleral buckle / retinectomy

- prevent recurrence / reproliferation
  - thorough endolaser

Goals of Diabetic Vitrectomy

- Remove all anteroposterior and tangential traction
  - avoid / minimize iatrogenic retinal breaks
  - membrane segmentation / delamination
  - judicious use of scleral buckle and retinectomy
Types of Retinectomy

- small posterior focal retinectomy
- large peripheral retinectomy

Goals of Diabetic Vitrectomy

- Maintain hemostasis
  - prevention
    - adequate visualization essential
    - preoperative bevacizumab
  - control
    - VGFI
    - tissue manipulator with diathermy
- prevent recurrence
  - thorough endolaser to ora serrata

Conclusions

- extent of vitreous attachment in eyes undergoing diabetic vitrectomy may be predictive:
  - reattachment
  - visual results
    - 0. total PVD
    - 1. focal vitreoretinal attachments
    - 2. broad vitreoretinal attachments
    - 3. vitreous attached at macula and arcades only
    - 4. vitreous attached from arcades to periphery
    - 5. no PVD