The Failed Filter: What Next?

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ESCRS, Berlin, Sunday 14th September 2008

Handout available from:

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Follow the link for ophthalmic professionals and look for ESCRs Berlin 2008.

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The Failed Filter – What next?

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The Failed Filter
– Healing and revising!

Keith Barton MD FRCP FRCS
Glaucoma Service Director
Moorfields Eye Hospital
London
The basic principle of filtration surgery (Trab / DS / Tube)

Some flow but not too much!

Resistance is set by the surgeon
The degree of resistance is based on a guess at how much healing is likely to occur and how much flow is likely to be too much.

Sites of trabeculectomy healing

<table>
<thead>
<tr>
<th>Early</th>
<th>Late</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clot</td>
<td>Release of blood &amp; plasma proteins</td>
</tr>
<tr>
<td>Leukocyte infiltration</td>
<td>Local fibrocyte transformation into fibroblasts</td>
</tr>
<tr>
<td>Chronic inflammation</td>
<td></td>
</tr>
</tbody>
</table>
Postoperative Wound Healing
Later (fibroblastic phase)
- Fibroblast proliferation
- Fibroblast migration

MMC / 5FU

Re-intervention
Options
- Further Trabeculectomy with MMC
- Revise failed trabeculectomy
- Aqueous Shunt

Further Trabeculectomy without MMC IS NOT AN OPTION

Success rate of Trabeculectomy in eyes with previous conjunctival surgery
Fluorouracil filtering surgery study (AJO 1996;121:349-366)
In this RCT published in 1996, 74% of repeat Trabs without anti-proliferatives failed

Revising the First Trabeculectomy
Pros
- Preserves conjunctiva
- Avoids off axis filtration
- Utilises any existing filtration
- Opportunity to improve bleb morphology (dysesthesia)

Cons
- Higher likelihood of failure
- Double MMC hit
- Potential for unguarded filtration - sclerostomy and conjunctiva may be necrotic

Repeat Trabs require MMC & therefore must be at 12 o’clock
Reasons to avoid revision of original trab

Risk of unguarded filtration
- Blocked sclerostomy
- Scarred conjunctiva
- Failure of MMC Trab
- Failure of more than one non-MMC trab
Sites of trabeculectomy healing

Episcleral fibrosis: no bleb, patent sclerostomy

Scleral healing: no bleb / odd bleb, patent sclerostomy
Sites of trabeculectomy healing

Encysted bleb: bleb, patent sclerostomy, often no scleral flap
Scleral necrosis

AC pressure equilibrates with sub-conjunctival space
Revision of the failing bleb is only occasionally worthwhile and is a specialist procedure
- The scleral flap may be necrotic
- Healing will be faster & more aggressive than first time around

Cases should be selected carefully and revision undertaken cautiously

If revising encysted blebs, have donor sclera standing by!

Conclusion

Thank you
Needle Revision For Filtration Failure

Nitin Anand
Calderdale & Huddersfield NHS Trust
West Yorkshire
UK

Conjunctival Filtration Bleb Failure

- Common after trabeculectomy
  - Early 10-40%
  - Late 50% or more

- Failure due to
  1. Subconjunctival fibrosis
  2. Episcleral and sub-scleral fibrosis
  3. Encapsulation (tenon's cyst)
  4. Internal obstruction by iris

Gonioscopy Before Needle Revision!

Early Bleb Failure

- Tortuous Conj Vessels
- Underlying Scleral Flap Not Visible
- Localising Bleb
- Absence of Microcysts
- Increasing IOP

Needle Revision - Considerations

- When?
- Where?
- Which type of bleb?
- What antimetabolite?
- Injection of antimetabolite before or after needling?
- How often can it be repeated?
- Technique: ‘puncture’ or ‘slash’?
- Complications?

Needle Revision

- In early failure, after suture-lysis and subconjunctival 5-FU
- Late failure, for as long as 20 years after trabeculectomy
- Can be done in an “office” setting where IOP can be checked to assess success
- In operating theatre, there is better control
### Bleb Morphology

- Encapsulated bleb, high rate of recurrence
- **Most appropriate indication** - subconjunctival fibrosis (raised, discrete, non-inflamed)
- Tight scleral flap (no conj elevation, scleral flap outline visible) more difficult

### Which Antimetabolite?

- **5-FU**
  - By convention 5mg administered (0.1 ml of 50mg/ml with lignocaine 2% 0.1 ml)
- **MMC**
  - Effective and safe dose for sub-conjunctival injection unclear (0.005 mg to 0.04mg)
  - Personal choice MMC 0.002mg (0.01ml of MMC 0.2mg/ml with lignocaine to make up 0.1 ml)
  - OR
    - Topical application of 0.2mg/ml for 3 mins

### Antimetabolite (AM) - Before Or After Needling?

**BEFORE**
- Can give mixture of lignocaine and AM
- Allows diffusion into subconj tissues and less likely to go into AC
- Difficult to assess successful fistulisation

**AFTER**
- No need to inject AM if needling not successful
- Can accurately assess success
- Risk of antimetabolite leaking into anterior chamber

### Needle Revision Technique - Pearls

- Assess level of resistance
- Inject antimetabolite (AM) subconjunctivally 10-20 minutes prior to procedure, away from bleb, 10 mm from limbus
- Larger the gauge of needle used for procedure, more the complications

### Needle Revision Technique - Pearls

- Entry site at ‘top’ rather than from side
- ‘Puncture’ better than ‘slash (sideways)’ technique-less complications
- If excessive bleeding, abandon procedure
- If blood tracks into anterior chamber ask patient to shut eyes tight
- Cauterise site of needle entry (optional)
- Take your time!

### Instrumentation

<table>
<thead>
<tr>
<th>29-Gauge Needle</th>
<th>Dual-bevel Paracentesis Knife</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal preference 25 gauge (3/4&quot;) inch</td>
<td></td>
</tr>
</tbody>
</table>
**Indicators Of Successful Needling**

- Gush of aqueous through needle entry site
- Blood in anterior chamber
- Significant drop of IOP to less than 5

**Post-Needling Management**

- Treat as after trabeculectomy
- Intensive topical steroids
- Supplementary 5-FU injections
- If using subconj MMC, avoid any further antimetabolite injections

**How Often Can It Be Repeated?**

- Needle revision + 5FU 2 weeks later IOP 7
- Month later - IOP 23, steroids tapered
- 2 Months - IOP 19, What next?

Repeat procedure only after inflammation decreases
SC 5-FU injection and increase topical steroids
Repeat needle revision not associated with increased success rates

**THE ENCAPSULATED BLEB**

Variable clinical course

*Randomised trial: NO benefit of needle revision with 5FU*
Spontaneous Resolution of Encapsulation (remodelling)

IOP 22mmHg at week 6
IOP 17 mmHg at year 1

Partial Resolution

IOP 14 mmHg at week 6
IOP 15 mmHg at month 6

Recurrence of Encapsulation

Month 2 - after one NR

Year 2

Year 3 - Flat bleb after NR + MMC!

Management of Encapsulated Blebs

Aqueous suppressants, topical steroids, digital massage(?)

Repeated bleb needling (?)

Surgical excision

Therapeutic levels in subconjunctival tissues after topical MMC application
Therapeutic levels in subconjunctival tissues after topical MMC application

Topical MMC Needling

Topical MMC- Needling

OUTCOMES

Needle Revision with 5-Fluorouracil

<table>
<thead>
<tr>
<th>Author</th>
<th>No</th>
<th>Mean Interval from index surgery in months (SD)</th>
<th>Mean Follow-up in months (SD)</th>
<th>Mean pre-needling IOP (SD)</th>
<th>Success criteria and rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotchford et al (2007)</td>
<td>81</td>
<td>NS</td>
<td>34</td>
<td>322 (17 mmHg at 3 years)</td>
<td>32% &lt;17 mmHg at 3 years</td>
</tr>
<tr>
<td>Broadway et al 2004</td>
<td>101</td>
<td>3.1 (median) 16 days-11 years (range)</td>
<td>18.7 (median) 8.3-52 (range)</td>
<td>26.7 (2.5)</td>
<td>50% at 1 yr &amp; 24% at 3 yrs &lt;17 mmHg, or a 29% drop at 1 year</td>
</tr>
<tr>
<td>Hawkins et al 2003</td>
<td>43</td>
<td>33 (36)</td>
<td>29 (16)</td>
<td>NS</td>
<td>49% &lt; target IOP at 1 year, 28% at 4 years</td>
</tr>
<tr>
<td>Shin et al 2001</td>
<td>64</td>
<td>14(27)</td>
<td>44(21)</td>
<td>31.80 (5)</td>
<td></td>
</tr>
</tbody>
</table>

Needle Revision with MMC

<table>
<thead>
<tr>
<th>Author</th>
<th>No</th>
<th>MMC Dose</th>
<th>Mean Interval from index surgery in months (SD)</th>
<th>Mean Follow-up in months (SD)</th>
<th>Mean pre-needling IOP (SD)</th>
<th>Success criteria and rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mardelli et al 1996</td>
<td>63</td>
<td>0.005mg</td>
<td>&gt;3</td>
<td>9.9 (3.7)</td>
<td>24.1 (6.4)</td>
<td>82.3% &lt;15 mmHg at last FU</td>
</tr>
<tr>
<td>Shetty et al 2005</td>
<td>44</td>
<td>0.04mg</td>
<td>NS</td>
<td>&gt;12 months</td>
<td>28 (8.2)</td>
<td>64 % bet 4-22mmHg at one year</td>
</tr>
<tr>
<td>Ture et al 2006</td>
<td>34</td>
<td>0.002mg</td>
<td>4.4 (3.8)</td>
<td>14.2 (8.8)</td>
<td>25.5 (4.4)</td>
<td>41% &lt;21 mmHg at last FU</td>
</tr>
</tbody>
</table>
**Adjunctive Antimetabolite with Needle Revision**

5-Fluorouracil 5mg or Mitomycin C 0.02mg?

*Anand et al., accepted for publication J Glaucoma*

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**Follow-up**

Significantly longer in 5-FU group

![Bar chart comparing 5-FU and MMC](Image)

**Comparative Results MMC vs. 5-FU Needle Revision IOP < 16mmHg**

![Survival analysis graph](Image)

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**Complete success for Kaplan Meier Survival Analyses**

- The probability of maintaining an IOP between 5-16 mm Hg without additional medications or glaucoma procedure

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**Significant Risk Factors for Success**

- **Mitomycin C**
  - (Hazard Ratio 2.18, 1.25-3.81, p = 0.006)
- **Immediate IOP drop**
  - (HR = 1.06, 95% CI, 1.00-1.13.8, p = 0.03)
- **Every mmHg lowering of IOP immediately after needling increased the chances of success by 6%.**

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**Bleb Morphology at Last Visit**

- **Flat/Scarred**
  - 5-FU 40%
  - MMC 37%
- **Diffuse**
  - 5-FU 15%
  - MMC 47%
- **Cystic**
  - 5-FU 45%
  - MMC 42%
Bleb avascularity after needle revision

- 5-FU 3 years IOP 15 mmHg
- MMC 3 years IOP 05 mmHg

Complications

1. Direct toxicity of 5-FU and MMC
2. Secondary to uncontrolled decompression of eye
3. Secondary to bleb morphology

- Studies on MMC ocular toxicity have used higher (x5) doses than used with needle revision

Complications

<table>
<thead>
<tr>
<th>Persistent choroidal effusions</th>
<th>5-Fluorouracil 53 eyes</th>
<th>Mitomycin C 45 eyes</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>01</td>
<td></td>
</tr>
<tr>
<td>Late bleb leaks</td>
<td>09</td>
<td>02</td>
</tr>
<tr>
<td>Blebitis</td>
<td>02</td>
<td>01</td>
</tr>
<tr>
<td>Aqueous misdirection</td>
<td>00</td>
<td>01</td>
</tr>
<tr>
<td>Delayed suprachoroidal hemorrhage</td>
<td>01</td>
<td>00</td>
</tr>
<tr>
<td>Corneal Decompensation</td>
<td>02</td>
<td>01</td>
</tr>
</tbody>
</table>

5-FU Needle Revision, Delayed Bleb Leak and Blebitis

Delayed Suprachoroidal Haemorrhage

Corneal Decompensation

Corneal Edema 2 Months After MMC 0.02mg Needling

Case Study- 72 yr female, Right Eye

- IOP 18 on 2 drops
- 24 on no treatment Trab +MMC-2002
- 2002: phaco
- 2 needlings (5FU)
- 2003: IOP 16-1 drops
- Trab +MMC-2003
- 2003-2004: IOP 17
- No response to meds MMC-needling

Bleb Appearance June 2007

- RE IOP 7mmHg, VA 6/6
- LE IOP 5mmHg, VA 6/5

Summary

- Needle revision is a quick, simple and convenient technique for bleb rejuvenation
- Learning curve and careful case selection
- Not a risk-free procedure and can lead to loss of vision
- Adjunctive MMC may increase success of needle revision but
DEEP SCLERECTOMY WITH MITOMYCIN C IN EYES WITH PREVIOUS FAILED GLAUCOMA SURGERY

Nitin Anand
Calderdale & Huddersfield NHS Trust
UK

Why Deep Sclerectomy?

- Postoperative IOP is related to intrascleral bleb height in eyes with clinically flat blebs following Deep Sclerectomy with Collagen Implant and Mitomycin C

Nitin Anand et al. Poster IGS Athens 2007

DS ‘Trabeculectomy with a membrane?’

Case Study

- 43, M, Chronic uveitis
- Previous RD surgery (Silicone Oil), Phaco+ Silicone Oil Removal
- Cycloidee for raised IOP (in 50s)
- VA: 6/18, Uncontrolled IOP on 4 meds (trav, pilo, brinz, timolol)
- CCT – 499um, C.D Ratio- 0.99
DS in complex uveitic glaucoma
- 1 wk post op IOP 7 mmHg
- 17 mths post op IOP 12 mmHg

DS in Eyes With Previous Surgery
- Difficult access
- Subconjunctival fibrosis
- Bleeding from scleral perforators
- Trabecular sclerosis

17 mths post op IOP 12 mmHg
36 mths IOP 12 mmHg on Timolol (19 mmHg sans)
Postoperative Outcomes

Case 1
IOP 12 mmHg at 4 years

Case 2
IOP 9 mmHg at 2 years

The ‘High-risk’ DS
Postoperative Management

- Aggressive bleb management like for trabeculectomy
- Earlier gonipuncture if high IOP
- Maintain aqueous flow

Failure in DS

Postoperative Management Of DS

- "Poor Flow" On Table
- Signs of Bleb Failure
- IOP ‘Target ‘Good’ Bleb

- Laser Puncture done
- No Iris Entrapment
- Grade III Angle
- Iris Entrapment
- Narrow Angle
- ‘Narrow’ TDM

- Sub Conj 5-FU
- Needlle Revision (SFU/MMC)
- YAG Gonio-puncture
- Argon + YAG Iridoplasty

Deep Sclerectomy in an eye with previous EGCE and

Assessing ‘FLOW’ thru the TDM

Good Flow
Laser goniopuncture: risk of iris entrapment!

Failed DS-Iris Incarceration in Perforation/ Laser Puncture

Argon Laser Iridoplasty for Iris Plugging Goniopuncture

Failed DS-Iris Incarceration in Perforation/ Laser Puncture

Repeat DS

Uveitic Glaucoma
ECCE, 3 Failed Trabs (1 MMC)
1 MMC Needle Revision
Deep Sclerectomy + MMC
IOP 40 mm Hg at 4 mths
YAG Goniopuncture
IOP at 48 mths 8 mm Hg

DS after Failed Glaucoma Surgery Outcomes

Methods
Database search of eyes with previously failed glaucoma surgery who had DS-MMC between August 2002 and Jan 2006.
57 eyes of 57 consecutive patients
Single surgeon series, intent-to-treat analysis

Survival Outcomes
IOP <3.9 mm Hg and 20% decrease from baseline

Complete Success
Without medications
Partial Success
With medications

IOP Outcomes (95% CIs)
Decrease of ≥2 Snellen VA lines - 1 patient so far

Subsequent Procedures

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Number of eyes (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nd:YAG laser goniopuncture</td>
<td>40 (3.9)</td>
</tr>
<tr>
<td>Needle revision with MMC</td>
<td>10 (17.3)</td>
</tr>
<tr>
<td>Early (&lt;3 months)</td>
<td>0</td>
</tr>
<tr>
<td>Late (5 years)</td>
<td>0</td>
</tr>
<tr>
<td>Argon laser iridoplasty</td>
<td>01 (1.7)</td>
</tr>
<tr>
<td>Reversal of phthisis for glaucoma</td>
<td>01 (1.7)</td>
</tr>
<tr>
<td>Scleral patch graft for hypotony</td>
<td>01 (1.7)</td>
</tr>
<tr>
<td>Nd:YAG laser capsulotomy</td>
<td>01 (1.7)</td>
</tr>
<tr>
<td>Argon laser closure of conjunctival blood vessels</td>
<td>01 (1.7)</td>
</tr>
</tbody>
</table>

Comparison with High-risk Trabeculectomy Outcomes in the Tube vs. Trabeculectomy Study

<table>
<thead>
<tr>
<th>Follow-up</th>
<th>DS-MVAC 1 year</th>
<th>TEC-IV 1 year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean number of previous surgeries</td>
<td>2.1 ± 0.6</td>
<td>2.1 ± 0.5</td>
</tr>
<tr>
<td>Mean IOP at one year (mmHg)</td>
<td>12.6 ± 4.3</td>
<td>12.7 ± 2.1</td>
</tr>
<tr>
<td>Mean post-op medications</td>
<td>0.2 ± 0.6</td>
<td>0.1 ± 0.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Complications (no. of patients)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypotony</td>
</tr>
<tr>
<td>Laser goniopuncture</td>
</tr>
<tr>
<td>Imerbium laser</td>
</tr>
<tr>
<td>Needle revision</td>
</tr>
</tbody>
</table>
Flow Control in Glaucoma Drainage Devices

K. Sheng Lim MD FRCOphth
Glaucoma Service
St Thomas' Hospital, London

GDD – main issues

Early post-op hypotony
Corneal decompensation
Long term success rate

Current GDD

<table>
<thead>
<tr>
<th>GDD</th>
<th>Plate Material</th>
<th>Plate Size</th>
<th>Resistance Mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molteno (1969)</td>
<td>Polypropylene &amp; Silicone</td>
<td>135 mm²</td>
<td>No</td>
</tr>
<tr>
<td>Baerveldt (1990)</td>
<td>Silicone</td>
<td>250 &amp; 350 mm²</td>
<td>No</td>
</tr>
<tr>
<td>Ahmed (1993)</td>
<td>Polypropylene &amp; Silicone</td>
<td>185 mm²</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Post-op IOP

Hypotony
Time

Week 6
Bleb resistance
Strategies to prevent hypotony

- Molteno & Baerveldt – Vicryl tube tie
- Molteno & Baerveldt - Supramid stenting
- Ahmed valve

Ahmed Glaucoma Valve main concerns

- Is the opening pressure consistent to prevent post-op hypotony?
- What happened to the valve resistance once bleb has form?

Does flow control mechanism in Ahmed work?

  - No
- Porter et al. Ophthalmology 1997; 104(10): 1701
  - Yes
  - Yes
  - Yes

Ahmed valve has flow control mechanism

Evaluation of Closing Pressure in Ahmed Glaucoma Valve
Moss, G.E. Trope. ARVO abstract 2007;3964

**Purpose:** Ahmed Glaucoma Valve closing pressure using a gravity driven flow system

**Methods:** 6 FP7 primed with BSS then assessed in flow rig

**Results:** All 6 AGV exhibited valve closure, with mean closing pressure was 8.2 ± 5.0 mmHg with a range of 2.5 to 14.6 mmHg.

**Conclusions:** Ahmed FP7 is prone to variations in closing pressure

FP7 can have inconsistent closing pressure
Gravity-driven Flow Test

- 13.6 cm H₂O = 10 mmHg
- BSS bottle
- Giving set
- 26 gauge cannula
- Primed Ahmed Valve before testing

No Flow
Ahmed Glaucoma Valve - Rejection

- Free flow of fluid at 7 mmHg
- No flow of fluid at 15 mmHg

Main concerns:
- Is the opening pressure consistent to prevent post-op hypotony?
- What happened to the valve resistance once bleb has form?

Post-op IOP – Ahmed Valve

<table>
<thead>
<tr>
<th>Time</th>
<th>IOP</th>
<th>Bleb resistance</th>
<th>Valve resistance</th>
<th>Hypotony</th>
<th>Hypertensive</th>
</tr>
</thead>
</table>

Tube Vicryl Tie

Video from Mr. K. Barton
Post-op IOP – Tube Vicryl Tie

**Hypertensive**

- Suture dissolve
- Bleb resistance

**Hypotony**

**Tie resistance**

**Time**

**IOP**

---

Post-op IOP – Tube Vicryl Tie

**Hypertensive**

**Combine resistance**

**Hypotony**

**Time**

**IOP**

---

Post-op IOP – Tube Vicryl Tie with needle perforation

**Hypertensive**

**Combine resistance**

**Hypotony**

**Time**

**IOP**

---


- Unpredictable results
- May still have risk of hypotony


---

**TABLE 6. Postoperative Complications in Tube versus Trabeculectomy Study**

<table>
<thead>
<tr>
<th>Complication</th>
<th>Tube Group n = 101 (M)</th>
<th>Trabeculectomy Group n = 405 (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choroidal effusion</td>
<td>17 (16)</td>
<td>23 (19)</td>
</tr>
<tr>
<td>Shallow or flat anterior chamber</td>
<td>12 (11)</td>
<td>11 (9)</td>
</tr>
<tr>
<td>Hypotony maculopathy</td>
<td>1 (1)</td>
<td>3 (5)</td>
</tr>
</tbody>
</table>
### Results from St Thomas’ Hospital

- **55 Baerveldt (June 06-June 08)**
- **Mean age 63**
- **Diagnosis:** failed trab, Uveitis, Anaridia, Aphakia, Neovascular & Epithelial downgrowth

### Baerveldt GDD (350) n= 55

- > 6 months FU (mean FU 10 months)
- No uveitis, previous cyclodiode & neovascular glaucoma
- 1 hypotony – resolved after 2 weeks
- 80% Supramid removed

### Conclusions

- Use Supramid stenting technique to prevent hypotony in non-valve GDD
- Test Ahmed Glaucoma Valve before implantation
- Vicryl tie with needle perforation can have significant risk of hypoptony
Thank You