Abstract

Aims—To evaluate the outcome of filtering procedures supplemented with mitomycin C in children with glaucoma.

Methods—All patients aged 17 or younger with glaucoma who underwent filtering surgery supplemented with mitomycin C at a tertiary care centre (n=21) during a 5 year interval (1992 and 1996) were included. One eye for each patient was entered into the analysis. The postoperative intraocular pressure (IOP), use of antiglaucoma medications, clinical stability of glaucoma, complications, and visual acuity were retrospectively evaluated. Kaplan–Meier survival curves were used to estimate the probability of success.

Results—At the time of surgery mean age was 5.7 (SD 5.0) years. The most common diagnoses were trabeculodysgenesis (n=6) and aphakic glaucoma (n=8). Mean IOP before surgery was 35.7 (10.5) mm Hg. Average length of follow up was 18.6 (14.7) months. The probability of having IOP less than 21 mm Hg with no antiglaucoma medications and with clinically stable glaucoma 1 year after surgery was 76.9% in phakic eyes (n=13) and 0% in aphakic eyes (n=8). A phakic patient with Sturge–Weber’s syndrome had choroidal effusion after surgery that resolved spontaneously. In the aphakic group one patient had retinal detachment and another developed an encapsulated bleb. Visual acuity deteriorated in one patient.

Conclusion—A guarded filtration procedure with mitomycin C is relatively successful in phakic children with glaucoma, but unsuccessful in aphakic ones.

The management of glaucoma in children in whom goniectomy or trabeculotomy has been unsuccessful or is inappropriate is problematic. In these patients filtering surgery without antimetabolites frequently fails, probably related to the greater thickness of Tenon’s capsule, the wound healing response in young patients, and the presence of conjunctival scarring from the previous ocular surgery. The use of antimetabolites with filtration procedure can reduce the frequency of filtration failure in glaucoma patients with a poor surgical prognosis. A guarded filtration procedure (GFP) in conjunction with an antiproliferative agent has recently been shown to be promising in selected patients with refractory paediatric glaucoma. Zalish et al reported a successful outcome of trabeculectomy with adjunctive subconjunctival injections of 5-fluorouracil in a small series of patient with congenital and infantile glaucoma. Several series of trabeculectomies with intraoperative mitomycin C to treat children with glaucoma have recently been reported. This study describes the outcome of filtering procedures supplemented with intraoperative mitomycin C in a North American paediatric population with glaucoma.

Methods

In a retrospective review, the medical records of all patients under 18 years old who had been treated by a GFP with mitomycin C at the glaucoma service of the Wills Eye Hospital from January 1992 to the end of January 1997 were reviewed.

One eye only from each patient was entered into the analysis. If both eyes underwent a GFP with mitomycin C at the same time, then the right eye was entered into the study. If both eyes underwent a GFP with mitomycin C at different times, then the first operated eye was selected. If an eye had more than one GFP with mitomycin C, then the first procedure was considered to be the surgery of record.

Mitomycin C (Bristol Laboratories, Syracuse, NY, USA) was reconstituted in balanced salt solution to yield a 0.4 mg/ml solution. The surgery was similar in all cases. A superior limbus based conjunctival flap was raised. Haemostasis was achieved with wet field cautery. A cellulose Weck-Cel sponge was soaked with mitomycin C and applied on the episclera, over the site of the planned scleral flap. The conjunctiva Tenon layer was draped over the sponge, avoiding contact of the mitomycin C with the wound edge. The time of exposure varied according to the surgeon’s estimation of risk of failure. After 1–5 minutes the sponge was removed and the entire area was irrigated thoroughly with balanced salt solution. A 3 × 3 mm rectangular scleral flap of one half scleral thickness was dissected. A 2 × 1 mm tissue block was removed, and a peripheral iridectomy was performed. The scleral flap was closed with single 10-0 nylon interrupted sutures, the number and placement of the sutures designed to allow what was believed to be an adequate amount of filtration. Conjunctiva and Tenon’s capsule layers were closed separately with 8-0 or 9-0 polyglactin (Vicryl)
Table 1  Demographics, diagnosis, preoperative data, and surgical outcome of guarded filtration procedure with mitomycin C

<table>
<thead>
<tr>
<th>Case No, sex, eye</th>
<th>Age (years)</th>
<th>Diagnosis</th>
<th>Previous antiglaucoma surgeries</th>
<th>IOP</th>
<th>No med</th>
<th>Follow up (months)</th>
<th>Success</th>
<th>Optic cup reversibility</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, m, w, r</td>
<td>0.1</td>
<td>aniridia</td>
<td>G, T</td>
<td>34</td>
<td>0</td>
<td>7</td>
<td>yes</td>
<td>yes</td>
<td>+</td>
</tr>
<tr>
<td>2, m, b, r</td>
<td>8</td>
<td>aphakia, microcornea</td>
<td>40</td>
<td>3</td>
<td>5</td>
<td>no</td>
<td>no</td>
<td>−</td>
<td></td>
</tr>
<tr>
<td>3, m, w, r</td>
<td>13</td>
<td>trabeculodysgenesis</td>
<td>32</td>
<td>3</td>
<td>13</td>
<td>yes</td>
<td>yes</td>
<td>−</td>
<td></td>
</tr>
<tr>
<td>4, m, b, l</td>
<td>6</td>
<td>Sturge-Weber’s</td>
<td>32</td>
<td>1</td>
<td>17</td>
<td>yes</td>
<td>yes</td>
<td>−</td>
<td></td>
</tr>
<tr>
<td>5, f, w, l</td>
<td>13</td>
<td>aniridia</td>
<td>27</td>
<td>2</td>
<td>8</td>
<td>yes</td>
<td>yes</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>6, m, w, r</td>
<td>0.4</td>
<td>trabeculodysgenesis</td>
<td>T, GFP</td>
<td>21</td>
<td>0</td>
<td>13</td>
<td>yes</td>
<td>yes</td>
<td>+</td>
</tr>
<tr>
<td>7, f, w, l</td>
<td>7</td>
<td>Rieber’s syndrome</td>
<td>40</td>
<td>0</td>
<td>6</td>
<td>yes</td>
<td>yes</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>8, f, w, r</td>
<td>3</td>
<td>aphakia</td>
<td>35</td>
<td>2</td>
<td>8</td>
<td>no</td>
<td>no</td>
<td>−</td>
<td></td>
</tr>
<tr>
<td>9, f, w, l</td>
<td>0.1</td>
<td>aphakia</td>
<td>47</td>
<td>2</td>
<td>23</td>
<td>yes</td>
<td>yes</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>10, m, w, l</td>
<td>8</td>
<td>aphakia, PHPV</td>
<td>36</td>
<td>0</td>
<td>6</td>
<td>yes</td>
<td>no</td>
<td>−</td>
<td></td>
</tr>
<tr>
<td>11, f, b, r</td>
<td>7</td>
<td>aphakia, microphthalmia</td>
<td>49</td>
<td>3</td>
<td>7</td>
<td>no</td>
<td>no</td>
<td>−</td>
<td></td>
</tr>
<tr>
<td>12, f, b, l</td>
<td>4</td>
<td>trabeculodysgenesis</td>
<td>G</td>
<td>30</td>
<td>53</td>
<td>yes</td>
<td>yes</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>13, f, w, r</td>
<td>9</td>
<td>Rieber’s anomaly</td>
<td>31</td>
<td>2</td>
<td>40</td>
<td>yes</td>
<td>yes</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>14, m, w, l</td>
<td>0.8</td>
<td>trabeculodysgenesis</td>
<td>T (&lt;2)</td>
<td>30</td>
<td>0</td>
<td>12</td>
<td>no</td>
<td>no</td>
<td>−</td>
</tr>
<tr>
<td>15, f, b, l</td>
<td>13</td>
<td>trabeculodysgenesis</td>
<td>T</td>
<td>28</td>
<td>3</td>
<td>8</td>
<td>yes</td>
<td>−</td>
<td></td>
</tr>
<tr>
<td>16, m, w, r</td>
<td>8</td>
<td>Peter’s anomaly</td>
<td>CCT</td>
<td>70</td>
<td>1</td>
<td>35</td>
<td>yes</td>
<td>−</td>
<td></td>
</tr>
<tr>
<td>17, f, w, r</td>
<td>3</td>
<td>aphakia, PHPV</td>
<td>32</td>
<td>0</td>
<td>9</td>
<td>no</td>
<td>no</td>
<td>−</td>
<td></td>
</tr>
<tr>
<td>18, m, w, r</td>
<td>5</td>
<td>aphakia</td>
<td>GFP</td>
<td>46</td>
<td>1</td>
<td>7</td>
<td>no</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>19, m, w, l</td>
<td>4</td>
<td>aphakia</td>
<td>31</td>
<td>3</td>
<td>39</td>
<td>yes</td>
<td>no</td>
<td>−</td>
<td></td>
</tr>
<tr>
<td>20, m, w, l</td>
<td>3</td>
<td>trabeculodysgenesis</td>
<td>G (&lt;2)</td>
<td>30</td>
<td>1</td>
<td>29</td>
<td>yes</td>
<td>yes</td>
<td>+</td>
</tr>
<tr>
<td>21, f, w, l</td>
<td>5</td>
<td>Sturge-Weber’s syndrome</td>
<td></td>
<td>29</td>
<td>1</td>
<td>42</td>
<td>yes</td>
<td>yes</td>
<td>+</td>
</tr>
</tbody>
</table>

IOP = intraocular pressure before filtration surgery; No med = number of antiglaucoma medications before filtration surgery; m = male; f = female; b = black; w = white; r = right; l = left; G = goniotomy; T = trabeculotomy; GFP = guarded filtration procedure; CCT = cyclocryotherapy; RD = retinal detachment; PVR = proliferative vitreoretinopathy.

suture on a tapered needle. After the conjunctival closure, balanced salt solution was again injected into the anterior chamber to test the amount of filtration and to ensure that the conjunctival closure was watertight.

Postoperative treatment was similar in all cases and consisted of corticosteroids (tapered over a 6–10 week period, depending upon the amount of conjunctival injection present), cycloplegics (for approximately 1 month), and antibiotics (for 2 weeks).

The available data varied among patients depending on their age. Visual acuities were not available in the youngest patients. An estimation of visual function was obtained by clinical methods which involve evaluation of fixating and following behaviour. Visual acuity (VA) in older children was evaluated by preferential looking tests and/or by the Snellen chart at 6 metres. Low vision was defined for this study as best corrected distance VA worse than 6/120. Worsening of VA was defined for older patients as a decrease in best corrected distance VA of two or more lines compared with baseline visual acuity. In younger children, worsening of vision was considered as absence of previous ability to fixate and follow objects.

Data on corneal diameters and axial length were available only in younger age groups. Visual fields were available only in older patients. In addition, some children who had advanced glaucoma before surgery had media opacities that were responsible for at least some of the visual impairment and which limited or prevented satisfactory visualisation of the optic discs. Because intraocular pressure (IOP) was the only variable evaluated consistently in all patients in this study, this variable was used as the principal criterion for assessment of surgical intervention.

Postoperative and preoperative IOPs were measured by application tonometry. In infants the IOP was measured under anaesthesia in the operating theatre. Tonometry was performed during the early moments after induction with inhaled anaesthetics and before endotracheal intubation. Intraocular pressure was measured with a Perkins applanation tonometer. In older children the IOP was measured in the clinic. The “preoperative IOP” was the ocular tension measured at the time of the decision to perform the surgical procedure. Postoperative measurements were recorded during follow up visits.
In this study success of GFP with mitomycin C was defined as follows: (1) "absolute success" was defined as a postoperative IOP less than 21 mm Hg with no antiglaucoma medications, with apparently stable glaucoma, and absence of severe complications. (2) "Relative success" was defined as no performance of or recommendation of further glaucoma surgery, and absence of severe complications (see definition above) associated with the filtering surgery.

The total length of follow up for each patient was considered to be the interval between the most recent follow up before the survey date and the date of surgery. For purposes of actuarial data analysis, the length of follow up was regarded as the length of follow up until the date of the detection of that failure (if either absolute or partial failure occurred).

The phakic and aphakic patients were evaluated separately. The influence of previous conjunctival incision and age (splitting the total population by the median age) was also analysed. The Kaplan–Meier survival curves were calculated for each of the failure categories.

**Results**

Twenty one patients were identified; 11 right eyes and 10 left eyes were analysed. The demographics of the patients are summarised in Table 1. The mean age was 5.7 (SD 5.0) years (median 6 years, range 1 month–17 years). The most common diagnoses were isolated trabeculodysgenesis (n=6) and aphakic glaucoma (n=8). One of the patients (case No 1) underwent bilateral and simultaneous GFP with mitomycin C.

In the aphakic patients cataract surgery was done within the first 6 months of age. Five patients underwent lensectomy, posterior capsulotomy, and anterior vitrectomy with automated vitrectomy instruments (cases 2, 8, 10, 11, and 17). A limbal approach was used in all patients but one (case 17) who underwent a pars plana vitrectomy and lens extraction. Three cases (cases 9, 18, and 19) underwent lens extraction and posterior capsulotomy, and later required secondary pupillary lens membrane removal with anterior vitrectomy. After cataract surgery there was no evidence of chronic inflammation. One patient (case 17) underwent surgical repair of retinal dialysis. After recognition of glaucoma, no signs of active inflammation were present. All cases but one (case 18) had an open angle. Before filtration surgery (Table 1) the average IOP was 35.7 (SD 10.5) mm Hg and the median number of antiglaucoma medications was one.

Previous glaucoma surgery had been performed on most phakic eyes (nine, 69.2%) but on only one aphakic eye in this series. The mean time of application of mitomycin C was 2.7 (1.0) minutes (median 3.0 minutes, range 1–5 minutes). In the phakic group the time of application of mitomycin C was 3.1 (1.0) minutes, and in the aphakic group 2.2 (0.9) minutes. At the time of GFP with mitomycin C an anterior vitrectomy was done in two aphakic patients (cases 11 (anterior approach) and 18 (through pars plana)).

Average follow up after surgery was 18.6 (14.7) months (median 14.0 months). The most recent follow up before the survey date associated with the filtering surgery.
postoperative IOP less than 21 mm Hg without antiglaucoma medications and with stable glaucoma (that is, absolute success) after 18 months of follow up was 47.6 % (Fig 1). The probability of having relative success (no further surgery or severe complications) was 67.4% after 18 months of follow up (Fig 2).

Phakic cases appeared to have a better outcome than did aphakic ones (Figs 3 and 4). After 18 months of follow up, the cumulative proportion of eyes with absolute success was 76.9% in the phakic group but 0% in the aphakic group. Similarly, the cumulative actuarial probability of relative success was 88.8% in the phakic group and 33.3% in the aphakic group after 18 months of follow up. Primary failure (high IOP and no evidence of filtration in the early postoperative period ) occurred in two aphakic cases (patients 2 and 17). No vitreous was observed in the anterior chamber and the cause of failure of these cases was unknown. Eyes without previous conjunctival incision (n=8) had higher actuarial probability of absolute and relative success than did eyes with previous conjunctival incision. Regarding age, children 5 years old or younger and those 6–18 years old had similar actuarial rates in both absolute and relative success.

The need for several postoperative subconjunctival injections makes the use of postoperative 5-fluorouracil in children difficult. Mitomycin C may be a better alternative to 5-fluorouracil in complicated glaucomas because there is no need of postoperative injections. The use of β irradiation in children was associated with a better surgical outcome than a control group. The use of 5-fluorouracil and mitomycin C in children with glaucoma undergoing filtration surgery has been reported recently. The need for several postoperative subconjunctival injections makes the use of postoperative 5-fluorouracil in children difficult. Mitomycin C may be a better alternative to 5-fluorouracil in complicated glaucomas because there is no need of postoperative injections (difficult to administer in children) and mitomycin C results in a lower postoperative IOP. Intraoperative mitomycin C is more potent than 5-fluorouracil and increases the success rate of filtration surgery in adults. Mitomycin C supplemented trabeculectomy had a high success rate (94.7%) in phakic Asian children with glaucoma with previously failed surgery (Table 3).

### Discussion

Many children with glaucoma respond adequately to one or more surgical procedures, usually goniotomy or trabeculectomy. When such surgery is unsuccessful or inappropriate, however, filtration surgery may become necessary. Filtration surgery in children gives less satisfactory results than in adults, and the outcome may be worse depending upon the type of glaucoma and whether or not there had been previous surgery. In children with complicated secondary glaucomas or with previously failed goniotomy, Beauchamp and Parks reported a high rate of complications and a success of 50% at 18 months. The use of β irradiation in children was associated with a better surgical outcome than a control group. The use of 5-fluorouracil and mitomycin C in children with glaucoma undergoing filtration surgery has been reported recently. The need for several postoperative subconjunctival injections makes the use of postoperative 5-fluorouracil in children difficult. Mitomycin C may be a better alternative to 5-fluorouracil in complicated glaucomas because there is no need of postoperative injections (difficult to administer in children) and mitomycin C results in a lower postoperative IOP. Intraoperative mitomycin C is more potent than 5-fluorouracil and increases the success rate of filtration surgery in adults. Mitomycin C supplemented trabeculectomy had a high success rate (94.7%) in phakic Asian children with glaucoma with previously failed surgery (Table 3).

### Table 3

<table>
<thead>
<tr>
<th>Author</th>
<th>No of patients/eyes</th>
<th>Type of glaucoma</th>
<th>Procedure</th>
<th>Criteria of success</th>
<th>% of successful cases (months of follow up)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandal et al</td>
<td>13/19</td>
<td>Congenital and developmental</td>
<td>GFP with mm C, 5 min, 0.4 mg/ml</td>
<td>IOP &lt;21 mm Hg without meds</td>
<td>60% (18)</td>
</tr>
<tr>
<td>Wallace et al</td>
<td>16/30</td>
<td>Congenital and developmental</td>
<td>GFP with mm C, 4 min, 0.2 mg/ml</td>
<td>IOP &lt;21 mm Hg without meds</td>
<td>61% (18)</td>
</tr>
<tr>
<td>Asrani and Wilensky</td>
<td>7/14</td>
<td>Aphakic GFP with mm C, 4 min, 0.4 mg/ml</td>
<td>IOP &lt;22 mm Hg</td>
<td>64% (18)</td>
<td></td>
</tr>
<tr>
<td>Wallace et al</td>
<td>9/13</td>
<td>Congenital and developmental</td>
<td>GFP with mm C, 4 min, 0.2 mg/ml</td>
<td>IOP &lt;26 mm Hg without meds</td>
<td>61% (18)</td>
</tr>
<tr>
<td>Mandal et al</td>
<td>21/21</td>
<td>Congenital, developmental</td>
<td>GFP with mm C, 1–5 min, 0.4 mg/ml</td>
<td>IOP &lt;21 mm Hg without meds</td>
<td>76% (18)</td>
</tr>
</tbody>
</table>

GFP = guarded filtration procedure; mm C = mitomycin C; IOP = intraocular pressure; meds = antiglaucoma medications; (?) = not mentioned in the study; *filtration surgery was associated with trabeculectomy.
Filtration procedures supplemented with mitomycin C in the management of childhood glaucoma

does not explain the di...
Filtration procedures supplemented with mitomycin C in the management of childhood glaucoma

Augusto Azuara-Blanco, Richard P Wilson, George L Spaeth, Courtland M Schmidt and James J Augsburger

Br J Ophthalmol 1999 83: 151-156
doi: 10.1136/bjo.83.2.151

Updated information and services can be found at:
http://bjo.bmj.com/content/83/2/151

These include:

References
This article cites 39 articles, 1 of which you can access for free at:
http://bjo.bmj.com/content/83/2/151#BIBL

Email alerting service
Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Topic Collections
Articles on similar topics can be found in the following collections

- Angle (1006)
- Glaucoma (988)
- Intraocular pressure (1002)
- Paediatrics (358)
- Lens and zonules (807)
- Neurology (1355)
- Ophthalmologic surgical procedures (1223)
- Retina (1608)

Notes

To request permissions go to:
http://group.bmj.com/group/rights-licensing/permissions

To order reprints go to:
http://journals.bmj.com/cgi/reprintform

To subscribe to BMJ go to:
http://group.bmj.com/subscribe/