Risk Factors for Late-Onset Infection Following Glaucoma Filtration Surgery

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Objective: To determine the risk factors for late-onset infection following glaucoma filtration surgery.

Methods: We performed a case-control study comparing 131 cases of late-onset infection collected from 27 surgeons at 10 centers with 500 controls matched for date of surgery and surgeon. The criterion for the presence of infection was severe anterior chamber reaction occurring later than 4 weeks after surgery. An opaque bleb and positive culture results were not required for diagnosis. Risk factors were identified by univariate and multivariate logistic regression analyses.

Results: Some of the risk factors that were statistically significant in the multivariate model after adjusting for age, race, and sex were (1) performance of a full-thickness rather than a guarded procedure (risk ratio [RR], 13.1; 95% confidence interval [CI], 2.12-80.9), (2) filtration surgery performed without concurrent cataract surgery (RR, 2.25; 95% CI, 1.24-4.08), (3) use of mitomycin (RR, 2.48; 95% CI, 1.06-5.83), (4) intermittent use of antibiotics after surgery (RR, 2.10; 95% CI, 1.09-4.02), and (5) continuous use of antibiotics after surgery (RR, 5.94; 95% CI, 2.09-16.9).

Conclusions: Eyes undergoing full-thickness procedures or filtration surgery without cataract extraction are at increased risk for late infection. Intraoperative mitomycin and episodic or continuous antibiotic use after the postoperative period are associated with an increased risk of infection.


During the past 3 decades there have been many reports of late-onset infections in eyes with filtration blebs, including case series of endophthalmitis1-16 defined by vitreous involvement, and the more recently recognized entity of blebitis in which the vitreous is not involved.2,5,14-18 These reports span the period during which full-thickness glaucoma procedures5,7,9,11-14,16-21 were replaced by partial-thickness procedures* and fluorouracil was introduced4,9,13,14,16-18 followed by mitomycin.1,2,4,13,15,18 These reports also include eyes with inadvertent filtration blebs following cataract surgery.3,9,11,14,21

The prognosis for eyes with late-onset endophthalmitis associated with filtration surgery is poor,3,12 with a recent study reporting a median visual acuity after endophthalmitis of 20/200.22 Furthermore, it has been suggested that the incidence of late-onset endophthalmitis is increasing.31 There has been much speculation as to what risk factors are associated with late-onset infection after filtration surgery. We report the results of a large multicenter case-control study of late-onset infection after glaucoma filtration surgery that investigated many possible risk factors.

The complete medical records of 131 patients with and 500 patients without late-onset infection following glaucoma filtration surgery, matched for surgeon and date of surgery, were identified. Glaucoma filtration surgery was performed by 27 experienced surgeons at 10 centers (Table 2). The dates of surgery ranged from August 12, 1980, to December 16, 1997 (Figure 1). The median length of time between the date of surgery and the diagnosis of infection was 1.7 years (range, 29 days to 10.9 years) (Figure 2). The length of time from symptoms to diagnosis in 7 full-thickness cases was 4.1±4.6 (mean±SD) days and in 123 partial-thickness procedures was 3.4±11.6...
METHODS

The Joint Committee on Clinical Investigation of The Johns Hopkins Hospital (Baltimore, Md) approved the research. Each case and each control was assigned an identifying number and all patient identifiers were removed from the database. We sought the participation of glaucoma surgeons who had observed the development of late-onset infection in their patients and were willing to have the medical records reviewed. We aimed for geographic diversity among the study sites.

CASE SELECTION

Surgeons were asked to recall the names of patients on whom they had performed glaucoma filtration surgery and who subsequently developed a late-onset infection. In several instances, surgeons had been keeping a list of such cases. Other sources of cases included hospital International Classification of Diseases, Ninth Revision (ICD-9) discharge codes and the records of vitreoretinal specialists who treated cases of late-onset infection after glaucoma filtration surgery. Some of the cases had previously been included in other reports of glaucoma surgical results. Cases had to have been operated on at the participating study center to ensure that preoperative and operative information could be obtained and so that appropriate controls could be selected. Only eyes operated on after January 1, 1980, were considered. Eyes were considered potential cases if they developed a hypopyon or an anterior chamber reaction recorded as greater than or equal to 2+ cell and 2+ flare at least 4 weeks after a glaucoma filtration operation, either alone or combined with cataract extraction. Eyes that had undergone drainage device surgery or trabeculectomy were excluded. Eyes with a previous history of inflammation or eyes that had persistent inflammation since the time of surgery were excluded unless there was a positive bacteriologic culture.

CONTROL SELECTION

For each case, a list was made of all trabeculectomies, full-thickness procedures, and combined cataract and glaucoma operations performed by the same surgeon within the 6 months before and the 6 months after surgery. This stipulation on the controls minimized the chance that the cases and controls would differ in terms of indications for surgery, surgical technique, and postoperative care. The list was derived from databases maintained by the surgeons, appointment books listing the names of patients undergoing surgery, and operating room logs.

The operations were ranked using a random number table. Starting with the operation ranked first, the medical records were sequentially examined for suitability as controls until up to 4 controls had been identified. The principal reason for excluding a potential control was that the length of follow-up after surgery for the control may have been less than 90% of the duration of follow-up for the case prior to the episode of endophthalmitis (otherwise, the “control” might really be a “case” that had simply not been followed up for long enough). Other reasons for excluding potential controls included incomplete medical records and incorrect identification of previous glaucoma surgery. If a patient had undergone glaucoma surgery in both eyes during this time frame, only the eye operated on closest to the date of surgery of the case was used. One hundred fifteen cases had 4 controls, 9 cases had 3 controls, 6 cases had 2 controls, and 1 case had 1 control. Some cases had less than 4 controls because of our inability to locate controls with follow-up comparable to the cases.

DATA ABSTRACTION AND ENTRY

A single study coordinator (L.A.K.-B.) who traveled to the glaucoma surgeons’ offices abstracted the information from the medical records. The information abstracted on a standardized data collection form included (1) patient characteristics, such as age, race, sex, history of systemic diseases, use of systemic corticosteroids and aspirin use; (2) ocular characteristics, including refractive error, previous ocular surgery, and type and severity of glaucoma; (3) intraoperative characteristics such as technique of glaucoma surgery, combination with cataract surgery, use of antibiotics agents, tenectomy, and antibiotic administration at the end of surgery; (4) postoperative characteristics such as wound leak, flat anterior chamber, and suprachoroidal hemorrhage, as well as blepharitis, dellen, trauma, leaking bleb, position and description of bleb, and record of intraocular pressures (IOPs); and (5) history of antibiotic treatment, contact lens use, use of eye drops in the operated or unoperated eye, use of artificial tears, and performance of bleb revision surgery.

DATA ANALYSIS

A univariate conditional logistic regression analysis using the PHREG procedure in SAS (SAS Institute Inc, Cary, NC) was performed to investigate the relationship between case status and each of the potential risk factors. Potential risk factors associated with case status with P values of .20 or less in the univariate analysis were entered into a conditional multiple logistic regression model. Both forwards and backwards stepwise regression procedures that retained variables with P values of .05 or less were performed. Only risk factors for which data were present for 93% or more of cases and controls were included. For example, although the variable “high bleb” was a strong risk factor in the univariate analysis, a description of the bleb as high or low was present in fewer than half of the cases and controls, and would have limited the model to a small percentage of the total cases and controls available. Age, race, and sex were included in the multivariate models regardless of level of statistical significance. Table 1 presents the variables from the univariate analysis that were included or excluded from the initial stepwise model. A P value of .05 or less was considered statistically significant in the conditional multiple logistic regression model.

(mean ± SD) days (P = .17, Wilcoxon signed rank test). Fifty percent of patients were aged between 60 and 76 years (range, 3-97 years), 53% were of European ancestry, 23% of African ancestry, and 22% were of unknown racial origin. Other demographic features of the cases and controls are presented in Table 3. Vitreous involvement was present in 123 (94%) cases; 82 (63%) had an opaque bleb, 89 (68%) had a hypopyon,
and 58 (44%) had all 3 findings (Table 4). Using the presence of vitreous involvement as the distinguishing feature between blebitis and endophthalmitis, there were 123 cases of endophthalmitis and 8 cases of blebitis. At the last visit prior to the diagnosis of late-onset bleb-related infection, the visual acuity of the cases was 20/50.

The mean±SD age of the cases was 63.4±16.7 years and that of the controls was 66.9±14.6 years. In the univariate analysis, younger age was a risk factor for infection, with a conditional risk of 1.08 for every 5 years of decreasing age (95% confidence interval [CI], 1.02-1.16; P=.01). Postoperative IOPs were 10.7±4.3 (mean±SD) mm Hg for the cases and 12.7±5.0 mm Hg for the controls. The conditional risk of developing an infection increased by 50% for every 3 mm Hg decrease in IOP (odds ratio, 1.50; 95% CI, 1.28-1.76; P<.001).

Univariate-matched analyses for discrete variables are presented in Table 5. Strong risk factors for the occurrence of late-onset, bleb-related infection included a
history of prior intraocular surgery, full-thickness filtration surgery, and the use of mitomycin; wound leak, flat anterior chamber, or suprachoroidal hemorrhage in the early postoperative period; and the presence of bleb leak or a high bleb. In addition, the use of antibiotics beyond the immediate postoperative period, either intermittently or continuously, was a strong risk factor. Other possible risk factors (risk ratio, $\geq 2.0$) included the use of systemic corticosteroid use, juvenile glaucoma, silk conjunctival sutures, pale-colored bleb, contact lens wear, bleb revision surgery, and use of epinephrine eye drops in the operative eye.

Combined cataract and glaucoma surgery, the presence of a superiorly located bleb, and the use of any glaucoma medications in the fellow eye (Table 5). Additional univariate-matched analyses that excluded the 8 cases of blebitis in one, and excluded the 17 cases diagnosed between 1 and 3 months after surgery in another, yielded the same results (data not shown).

The initial conditional multiple logistic regression model identified statistically significant associations between previous surgery, full-thickness surgery, glaucoma surgery without concurrent cataract surgery, lower postoperative IOP, episodic or continuous postoperative use of antibiotics, and lack of use of glaucoma medications in the fellow eye (Table 6). Mitomycin was not associated with late-onset infection in this initial model. When we excluded variables from the model that might be related to the use of mitomycin, such as previous intraocular surgery, the presence of a bleb leak, the episodic or continuous use of antibiotics postoperatively, and the average IOP during the postoperative period, the use of mitomycin became strongly associated with the development of an infection. Furthermore, the use of mitomycin remained in the model as all variables were added back to the model except for previous surgery (Table 7). The use of fluorouracil was not statistically significant ($P = .23$), although its effect was in the direction of a risk factor.

**COMMENT**

The risk factors for late-onset infection following glaucoma filtration surgery have not been well characterized. Most reports in the literature are small case series, and hence are not amenable to a case-control analysis necessary for identifying risk factors. The recent publication of a case-control study of infection after glaucoma filtration surgery is an important addition to the literature. However, the number of cases enrolled was relatively small, and controls were matched to cases by the use of antifibrosis agents, eliminating the possibility of determining whether antifibrosis agents were associated with an increased risk of late-onset bleb-related infection. We set out to design a study with numbers of cases and controls sufficient to allow the identification of statistically significant associations. This involved pooling the experiences of many practices, which allowed us to assemble what we believe to be the largest number of cases of late-onset infection after glaucoma filtration surgery to date.
We used the univariate analysis to point out risk factors that might be important, but whose representation in the medical records were so incomplete (bleb description), or occurrence so infrequent (use of systemic corticosteroids), that they could not be entered into a multivariate model (Table 1). Furthermore, the univariate analysis could point out risk factors, such as bleb leak, that may not have been significant in the multivariate model owing to close association with other variables.

Our univariate analysis confirms the findings of others that inferiorly located blebs are associated with a high incidence of late-onset infection. The univariate analysis also suggests an association between the notation of a high bleb and the presence of blepharitis with the development of an infection. A high bleb may be more susceptible to penetration by pathogens in the conjunctiva, while eyes with blepharitis may have a greater load of bacteria, thus predisposing them to infection.

Another important potential association detected in our univariate analysis, but not in the multivariate analysis, is between a history of bleb leak and the subsequent development of an infection (risk ratio, 3.7; 95% CI, 2.19-6.25). Soltau et al recently reported on 55 consecutive cases of bleb-related infection occurring at 2 institutions. Some of their cases and controls were included in our study. They found that eyes with bleb-related infections were 26 times as likely to have a bleb leak detected at the time of infection than eyes without a bleb-related infection. They found a nearly significant association (P = .07) between a history of a preexisting bleb leak and the subsequent development of an infection. It seems biologically plausible that a bleb with a visible breach in its wall would be at greater risk for infection than one whose surface was intact.

Multivariate analyses are critical because they adjust for the presence of many related variables. However, multivariate models can be influenced by the choice of variables that are included in the model. When 2 variables that are closely associated are placed in a model, sometimes only 1 will remain significant. Furthermore, including a variable that is in the causal pathway will remove a true association. A classic example of this would be a regression model looking for an association with skin cancer that includes both freckles and sun exposure. Keeping freckles in the model may falsely remove the association between skin cancer and sun exposure.

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In our multivariate analysis, we found that a history of prior surgery, but not the use of mitomycin, was significantly associated with infection. One possible explanation for this is that a history of previous surgery led the surgeons to use mitomycin, which then produced a thin bleb, followed by a bleb leak, and ultimately an infection. This pathway to infection is supported by the findings of Greenfield et al, who demonstrated that the blebs in eyes that have undergone combined cataract and glaucoma surgery are thicker than those that undergo trabeculectomy alone supports this hypothesis. The observation by Greenfield et al that the blebs in eyes that have undergone combined cataract and glaucoma surgery are thicker than those that undergo trabeculectomy alone supports this hypothesis.

Some studies have suggested that mitomycin is a risk factor, whereas others have concluded that it is not. Others have suggested fluorouracil to be a risk factor, contrary to our findings. The limitations of our medical record review precluded an analysis by dose, duration, or route of administration of the antifibrosis agent.

The notation of any of the early postoperative complications of flat anterior chamber, wound leak, and suprachoroidal hemorrhage were not significant risk factors. Although these results have been described in the literature,26 we did not find an association between late-onset bleb-related infection and a history of previous surgery.

In our study, there were no preoperative characteristics of either patients or eyes that were risk factors. In terms of variables occurring at the time of surgery, the performance of a full-thickness rather than a guarded filtration procedure was a strong risk factor, with a risk ratio of 13.1. This confirms the findings of Sastry et al, who in analyzing the Medicare database for hospital admissions for endophthalmitis following glaucoma surgery, found a history of a full-thickness procedure disproportionately represented. On the other hand, the performance of combined cataract and glaucoma surgery vs glaucoma surgery alone seemed to be protective against the development of infection most likely because the glaucoma portion of the combined procedure results in thicker blebs than glaucoma surgery alone. The observation by Greenfield et al that the blebs in eyes that have undergone combined cataract and glaucoma surgery are thicker than those that undergo trabeculectomy alone supports this hypothesis.

Some studies have suggested that mitomycin is a risk factor, whereas others have concluded that it is not. Others have suggested fluorouracil to be a risk factor, contrary to our findings. The limitations of our medical record review precluded an analysis by dose, duration, or route of administration of the antifibrosis agent.

The notation of any of the early postoperative complications of flat anterior chamber, wound leak, and suicide.

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**Table 5. Univariate Matched Analyses of Risk Factors For Late-Onset Infection After Glaucoma Filtration Surgery (cont)**

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>No. (%) of Cases</th>
<th>No. (%) of Controls</th>
<th>Conditional Risk Ratio (95% CI)*</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postoperative characteristics (first 4 weeks after surgery)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wound leak</td>
<td>24 (18.3)</td>
<td>31 (6.2)</td>
<td>3.51 (1.94-6.35)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Flat anterior chamber</td>
<td>11 (8.4)</td>
<td>10 (2.0)</td>
<td>5.16 (1.97-13.5)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Suprachoroidal hemorrhage</td>
<td>19 (14.7)</td>
<td>24 (4.9)</td>
<td>4.02 (1.92-8.41)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Postoperative characteristics (≥4 weeks after surgery)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blepharitis‡</td>
<td>30 (22.9)</td>
<td>67 (13.4)</td>
<td>1.92 (1.17-3.14)</td>
<td>.009</td>
</tr>
<tr>
<td>Ocular trauma</td>
<td>1 (0.8)</td>
<td>2 (0.4)</td>
<td>2.00 (0.18-22.1)</td>
<td>.57</td>
</tr>
<tr>
<td>Bleb leak</td>
<td>33 (25.2)</td>
<td>44 (8.8)</td>
<td>3.70 (2.19-6.25)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Dellen</td>
<td>3 (23)</td>
<td>15 (3.0)</td>
<td>0.72 (0.21-2.55)</td>
<td>.61</td>
</tr>
</tbody>
</table>

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*CI indicates confidence interval.
†Percentages are not always based on total number of cases and controls because of missing data. For instance, race was not specified in the records of some patients.
‡Blepharitis recorded in the medical record between the time of glaucoma surgery and the diagnosis of infection.
§Any record of ocular topical antibiotic use between the time of glaucoma surgery and the diagnosis of infection.
prachoroidal hemorrhage was associated with the development of late-onset infection. Mochizuki et al26 found early wound leak to be a risk factor in their study of 11 infections developing after 632 trabeculectomies. Perhaps these complications are associated with problems with the filtration operation that later manifest themselves in a bleb that is more prone to late-onset infection. For example, eyes with a flat anterior chamber owing to overfiltration may more often develop a thin bleb that could in turn predispose to late-onset infection.

The association of antibiotic use postoperatively and late-onset infection is a provocative finding. To interpret the significance of this association, it is necessary to clarify that because we performed a conditional analysis, cases were matched with controls who had the same surgeon. Therefore, the association we found between antibiotic use and late-onset infection means that individual surgeons must have used antibiotics postoperatively in certain patients but not others. However, the multivariate analysis demonstrates that antibiotic use is associated with the development of infection, independent of the other variables that we examined, such as blepharitis or bleb leak. Then why would a surgeon use antibiotics in some patients and not others? Perhaps they were used in response to some other variable that we did not consider or that was not noted in the medical record.

Given this caveat, our finding of a strong association between the use of antibiotics after surgery and late-onset infection raises the possibility that the use of antibiotics, particularly in a continuous fashion, could increase the likelihood of an infection. Lamping et al20 reported that in 4 cases of late-onset endophthalmitis, 3 were receiving continuous prophylactic antibiotics at the time of infection. It could be that the antibiotics select for virulent bacteria that cause serious infection. However, the study by Wand et al27 does not support this hypothesis. They performed conjunctival cultures in eyes that had been treated with antibiotics after filtration surgery and found no difference from the untreated, unoperated fellow eye in the bacterial flora. Unfortunately, we did not capture information about the antibiotic sensitivities of the organisms cultured from the cases to test this hypothesis. Even if we had such information, case-control studies such as this can establish associations, but not cause and effect. Thus, we cannot prove that the use of antibiotics increases the risk of infection. However, these data suggest that further study is needed to justify the use and safety of postoperative antibiotics.

Our study design does not shed any light on the prevalence of late-onset infection after glaucoma filtration surgery. To determine this definitively, a prospective observational study of thousands of glaucoma operations annually would be needed. Two retrospective studies of endophthalmitis following trabeculectomy with mitomycin have recently been published. In the first, 6 cases occurred following 229 trabeculectomies with mitomycin, with a mean follow-up of 18 months, an approximate rate of 1.8% per year.4 In the second, bleb-associated endophthalmitis developed in 13 cases, an average of 18.5 months following 609 trabeculectomies with mitomycin, a rate of 1.4% per year.6

There are limitations to our analysis. Because we only studied the patients of glaucoma specialists, our study may not be generalizable to glaucoma surgery performed by nonspecialists. Also, our study design depended on surgeon recall of cases of endophthalmitis that

### Table 6. Conditional Multiple Regression Model of Risk Factors of Late-Onset, Bleb-Related Infection Following Glaucoma Filtration Surgery*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Risk Ratio (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increasing age in 5-y intervals</td>
<td>0.94 (0.87-1.02)</td>
<td>.15</td>
</tr>
<tr>
<td>Male sex</td>
<td>1.28 (0.80-2.06)</td>
<td>.31</td>
</tr>
<tr>
<td>Nonwhite race compared with white</td>
<td>0.60 (0.27-1.33)</td>
<td>.20</td>
</tr>
<tr>
<td>Unknown race compared with white</td>
<td>0.55 (0.29-1.05)</td>
<td>.07</td>
</tr>
<tr>
<td>Glaucoma surgery alone</td>
<td>13.5 (2.19-83.2)</td>
<td>.005</td>
</tr>
<tr>
<td>(without cataract surgery)</td>
<td>1.95 (1.08-3.51)</td>
<td>.03</td>
</tr>
<tr>
<td>Mean IOP from surgery until diagnosis of infection</td>
<td>0.88 (0.83-0.93)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Mean IOP from surgery until diagnosis of infection</td>
<td>2.13 (1.11-4.06)</td>
<td>.02</td>
</tr>
<tr>
<td>Continuous antibiotic use</td>
<td>9.07 (3.41-24.2)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Use of glaucoma medications</td>
<td>0.56 (0.33-0.94)</td>
<td>.03</td>
</tr>
</tbody>
</table>

*CI indicates confidence interval; IOP, intraocular pressure.

### Table 7. Modified Conditional Multiple Regression Model of Risk Factors for Late-Onset Bleb-Related Infection (History of Prior Ocular Surgery Excluded)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Risk Ratio (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increasing age in 5-y intervals</td>
<td>0.94 (0.87-1.03)</td>
<td>.17</td>
</tr>
<tr>
<td>Male sex</td>
<td>1.27 (0.78-2.05)</td>
<td>.33</td>
</tr>
<tr>
<td>Nonwhite race compared with white</td>
<td>0.64 (0.29-1.42)</td>
<td>.27</td>
</tr>
<tr>
<td>Unknown race compared with white</td>
<td>0.56 (0.29-1.08)</td>
<td>.08</td>
</tr>
<tr>
<td>Full-thickness surgery</td>
<td>13.1 (2.12-80.9)</td>
<td>.006</td>
</tr>
<tr>
<td>Glaucoma surgery alone</td>
<td>2.25 (1.24-4.08)</td>
<td>.007</td>
</tr>
<tr>
<td>(without cataract surgery)</td>
<td>2.48 (1.06-5.83)</td>
<td>.04</td>
</tr>
<tr>
<td>Mean IOP from surgery until diagnosis of infection</td>
<td>0.88 (0.83-0.93)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Mean IOP from surgery until diagnosis of infection</td>
<td>2.10 (1.09-4.02)</td>
<td>.03</td>
</tr>
<tr>
<td>Continuous antibiotic use</td>
<td>5.94 (2.09-16.9)</td>
<td>&lt;.009</td>
</tr>
<tr>
<td>Use of glaucoma medications</td>
<td>0.57 (0.34-0.95)</td>
<td>.03</td>
</tr>
</tbody>
</table>

*CI indicates confidence interval; IOP, intraocular pressure.
occurred during a long period. There were undoubtedly cases that were not recalled, and the effect of not including these forgotten cases in our analysis cannot be determined. Finally, statistical analysis using linear regression models merely determine whether outcomes and covariates are statistically related, and not whether they are causally related.

On the basis of our analyses, we recommend that full-thickness filtration procedures and trabeculectomies performed at locations other than the superior limbus be performed only if the indications are compelling. The possibility that mitomycin could increase the risk of late-onset endophthalmitis should be factored into the risk/benefit equation determining its use in an individual eye. Surgeons ought to think carefully before embarking on an intermittent or chronic course of antibiotics as prophylaxis against blebitis or endophthalmitis. Patients whose eyes have received mitomycin had a serious complication in the immediate postoperative period, have a bleb that appears high or thin, have a bleb leak, or have tempted the surgeon to consider or initiate antibiotic therapy need to be monitored particularly closely for the earliest signs of infection. It seems that the most successful filtration operations, in eyes with low IOP and receiving no medication, are at greatest risk. All patients, but particularly the patients just described, should be provided with specific instructions on how to obtain emergency care and instructed to inform their surgeon immediately of the signs and symptoms of possible infection. We believe that detection at the earliest stages of infection will result in better outcomes, but this assumption also merits further study.

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REFERENCES