Objective: To determine the indications and outcome of conjunctival advancement surgery for late-onset filtering bleb leaks.

Patients and Methods: Retrospective medical record review of a consecutive case series of all patients who underwent conjunctival advancement surgery for persistent late-onset glaucoma filtering bleb leaks at a tertiary referral center between December 1, 1985, and April 30, 1997.

Main Outcome Measures: Indications for surgery, preoperative and postoperative intraocular pressure (IOP), visual acuity, status of bleb leak, and need for reinstitution of medical therapy or reoperation for glaucoma.

Results: Twenty-six eyes of 26 patients were analyzed. Complications from bleb leaks that necessitated surgical intervention included chronic ocular hypotony (n = 21), decreased visual acuity (n = 9), bleb-related infection (n = 11), hypotony maculopathy (n = 4), corneal edema with folds (n = 7), choroidal effusion (n = 3), and persistent shallow anterior chamber (n = 3). The mean ± SD preoperative IOP was 5.7 ± 4.9 mm Hg (range, 0-16 mm Hg). After a follow-up of 19.6 ± 22.6 months, the IOP was 14.2 ± 4.1 mm Hg for patients taking 1.1 ± 1.3 glaucoma medications (all data given as mean ± SD). Twelve patients (46%) had early-onset bleb leaks after revision, of which 7 (27%) closed spontaneously and 5 (19%) required resuturing. Two patients (8%) had a persistent bleb leak throughout the follow-up period. Thirteen patients (50%) required reinstitution of medical therapy during the follow-up period, and 2 (8%) required a reoperation for glaucoma for uncontrolled IOP.

Conclusions: Conjunctival advancement is a successful procedure for closing late-onset filtering bleb leaks. Some patients require suturing in the early postoperative period, but most patients eventually obtain permanent closure of the leak. Patients should be counseled of the possibility of requiring medical or surgical intervention for IOP control after revision.


Complications of late-onset filtering bleb leaks include decreased visual acuity (related to hypotony, corneal folds, or maculopathy), shallow or flat anterior chamber, and chronic tearing. In addition, filtering bleb leaks have been implicated in bleb-related infections (blebitis or endophthalmitis). Figure 1 shows an example of a thin, ischemic filtering bleb with surrounding hyperemia from a Staphylococcus aureus bleb infection. Figure 2 shows the positive Seidel test result for this same patient.

Although many nonsurgical techniques have been tried to close late-onset bleb leaks, successful closure often requires surgical revision. Advancement of conjunctiva from the adjacent conjunctiva, Tenon layers, or both and free conjunctival autografts are the 2 techniques most frequently used. Although the technique of conjunctival advancement has
PATIENTS AND METHODS

After approval by the University of Miami School of Medicine, Miami, Fla, Human Subjects Committee (Protocol No. 97/185), a computerized search of all operating room procedures between December 1, 1985, and April 30, 1997, coded as bleb revision was conducted. Medical records were then reviewed for surgical indication, and only those patients who were operated on for documented (positive Seidel test result) late-onset glaucoma filtering bleb leaks were included in the retrospective review. Patients were excluded if the onset of the leak was in the immediate postoperative period (<3 months), if a scleral patch graft was used to close the trabeculectomy flap during bleb revision, or if the patient had less than 3 months' follow-up after revision.

All surgery was performed or supervised by a member of the glaucoma service in the Department of Ophthalmology, University of Miami School of Medicine, using the following technique. Surgery was performed under local anesthesia with monitored sedation. A 7-0 polyglactin 910 (Vicryl) traction suture was placed through the peripheral cornea at the 12-o'clock position, and the globe was rotated inferiorly. A large conjunctival peritomy was performed, including conjunctiva 1 to 2 clock hours adjacent to the existing filtering bleb. The old filtering bleb was excised, and the conjunctiva and Tenon layer superior to it were mobilized to allow for advancement of the conjunctiva to the peripheral cornea. Additional sutures were added to the partial-thickness trabeculectomy flap if the anterior chamber was unable to be maintained with balanced salt solution or if excessive flow of aqueous humor was noted. The peripheral corneal epithelium was debrided with a No. 64 blade or bipolar cautery to allow better adhesion of the conjunctiva. Single interrupted 10-0 nylon or 7-0 polyglactin 910 "wing" sutures were used temporally and nasally and 10-0 nylon mattress sutures (in 20 cases) or a running suture (in 6 cases) were used to secure the conjunctiva to the peripheral cornea. One patient had 2 wing sutures alone, without mattress or running sutures to secure the conjunctiva to the peripheral cornea. No specific attempt was made to advance the Tenon layer during the conjunctival advancement. A paracentesis track was used to inject balanced salt solution into the anterior chamber to confirm flow into the newly created filtering bleb and to check for leakage with the Seidel test. The traction suture was removed, and subconjunctival injections of antibiotics and corticosteroids were given in the inferior conjunctiva. The eye was patched until the next morning, after which corticosteroid eyedrops were administered every hour while awake, followed by a tapering schedule as indicated. Injections of 5-fluorouracil were given to some patients at the surgeon’s discretion. Seidel testing was performed at each postoperative visit within the first 3 months, and resuturing was performed for persistent leakage as indicated under topical anesthesia using 10-0 nylon or 8-0 polyglactin 910 interrupted or mattress sutures. Medications were added if the intraocular pressure (IOP) was considered too high for the amount of optic nerve damage, visual field loss, or both. Repeat glaucoma filtering surgery was performed for patients in whom medical therapy failed.

Medical records were reviewed for preoperative clinical and demographic characteristics; indications for surgery; intraoperative surgical technique; and postoperative outcome, including visual acuity, IOP, number of glaucoma medications, reoperation for glaucoma, and complications related to the surgery. Hypotony was defined as an IOP of 5.5 mm Hg or lower. The postoperative visual acuity was considered the same if it was within 1 line of the preoperative visual acuity. Complete success was defined as resolution of the bleb leak postoperatively and no need for long-term glaucoma medications or reoperation for glaucoma. Qualified success was defined as resolution of the bleb leak postoperatively and no need for reoperation for glaucoma but a persistent need for 1 or more glaucoma medications to control IOP. Placement of additional sutures to repair immediate postoperative leaks was not considered a failure or a qualified success. These patients were included in either group depending on their need for medications. Patients who had persistent bleb leaks after revision were considered complete failures. For survival analysis, the date of failure for these patients was considered to be at the 1-day postoperative visit, which is when the nonresolving bleb leak was noted. Patients who underwent additional glaucoma surgery for uncontrolled IOP were classified as complete failures, and the date of the reoperation was used as the date of failure. Kaplan-Meier survival analysis was used to assess the time course of failure. Cox regression analysis was used to determine risk factors for complete and qualified failure of revision surgery. Intraocular pressure data from patients who underwent reoperation for glaucoma during the follow-up period were censored subsequent to the reoperation date. Results are given as the mean ± SD where applicable.

been described in the literature, there are no studies that examine the indications for, and outcomes of, this technique. In addition, no articles have been written describing the indications and outcomes of conjunctival advancement for late-onset filtering bleb leaks since the advent of trabeculectomy with adjunctive antifibrotic agents. The present study analyzes the indications and outcomes of conjunctival advancement surgery, our current surgical method of closing late-onset leaks in glaucoma filtering blebs.

RESULTS

Twenty-eight patients underwent conjunctival advancement for late-onset bleb leaks during the study period. Two patients were excluded from the analysis because they had less than 3 months' follow-up after revision. The first of these was followed up for 2 months but then became ill and died at age 87 years, 8 months after revision. At last follow-up, the filtering bleb was Seidel test negative and the IOP was 7 mm Hg, with no glaucoma medications being taken. A second patient was unavailable for follow-up after 1 month and also died several months later at age 88 years. In this patient, the IOP was 17 mm Hg at last follow-up, with no glaucoma medications being taken, and the filtering bleb was Seidel test negative at the last follow-up visit.

Demographic and clinical characteristics of the 26 patients who were analyzed are given in the Table. The average number of surgeries in the operated eye, in-
The average time between filtration surgery and the date when the bleb leak was noted in the medical record was 2.9 ± 2.3 years (range, 12.5 weeks to 11.3 years). All but 2 cases occurred after 1990, and the peak incidence was in 1996 (10 of the 26 cases). The time between filtration surgery and revision surgery was 3.2 ± 2.3 years (range, 4.3 months to 11.3 years). The time between the date the bleb leak was noted and revision surgery was 115 ± 163 days (range, 5-571 days).

Complications from bleb leaks that necessitated surgical intervention are as follows:

<table>
<thead>
<tr>
<th>Complication</th>
<th>No. of Patients</th>
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<tbody>
<tr>
<td>Chronic bleb leak</td>
<td>26</td>
</tr>
<tr>
<td>Chronic ocular hypotony</td>
<td>21</td>
</tr>
<tr>
<td>Bleb-related infection</td>
<td></td>
</tr>
<tr>
<td>(blebitis or endophthalmitis)</td>
<td>11</td>
</tr>
<tr>
<td>Hypopyon maculopathy</td>
<td>4</td>
</tr>
<tr>
<td>Corneal edema with folds in the Descemet membrane</td>
<td>7</td>
</tr>
<tr>
<td>Persistent choroidal effusion</td>
<td>3</td>
</tr>
<tr>
<td>Persistent shallow anterior chamber</td>
<td>3</td>
</tr>
</tbody>
</table>

One patient had 3 different Seidel test–positive leaks with normal preoperative IOPs and no other indication for revision. This patient had culture-negative conjunctivitis, and revision was performed because of presumed increased risk of bleb-related infection. Seven of the 26 patients were considered monocular (having either an enucleated or a blind contralateral eye). In attempts to resolve the leak, 8 patients were patched, 7 had an oversized contact lens placed, 7 received aqueous suppressants, 6 received compression stitches, 2 had mecylate tissue adhesive placed, 1 failed 2 autologous blood injections, and 2 underwent treatment with trifluoroacetate. The mean number of conservative treatments before revision was 2.2 ± 1.0 (range, 0-5). Three patients had additional scleral flap sutures (range, 1-3) placed at the time of conjunctival advancement. Nine patients received postoperative 5-fluorouracil injections (range, 5-30 mg) to prevent scarring.

The mean preoperative IOP was 5.7 ± 4.9 mm Hg (range, 0-16 mm Hg). The final IOP after an average follow-up of 19.6 ± 22.6 months (range, 5.2-122.0 months) was 14.2 ± 4.1 mm Hg (range, 8-23 mm Hg). As shown in Figure 3, IOPs averaged 13.0 to 16.3 mm Hg during the follow-up period. Except for 1 patient who underwent emergency glaucoma surgery 1 day postoperatively for an IOP of 76 mm Hg, there were no early (<1 week postoperative) IOP spikes.
institution of medical therapy within the first 3 months. Fourteen (50%) of the 26 patients required glaucoma medications during the follow-up period. Most patients (n = 9) who required medical therapy for glaucoma reinstituted within the first 6 months postoperatively. One of these patients, who had an IOP of 36 mm Hg, required a glaucoma drainage implant 2 months postoperatively because of advanced glaucoma damage and intolerance to all glaucoma medications. The second patient required a second bleb revision with mitomycin C combined with a glaucoma drainage implant 1 day after the original bleb revision for an IOP of 76 mm Hg. Two other patients underwent glaucoma surgery in conjunction with nonglaucoma surgery during the follow-up and were not classified as failures. One of these patients had combined cataract and glaucoma surgery 10 years after bleb revision. Before reoperation, the IOP was 19 mm Hg while taking 1 glaucoma medication, and surgery was performed primarily for cataract. This patient was classified as a qualified success because the IOP was controlled medically. The other patient underwent a combined penetrating keratoplasty and the insertion of a glaucoma drainage implant 9 months after bleb revision. This patient had cornel graft rejection and an elevated IOP secondary to topical corticosteroid use. The elevated IOP was controlled with 3 glaucoma medications and, despite an IOP of 15 mm Hg, a glaucoma drainage implant was placed at the time of penetrating keratoplasty. This patient was also classified as a qualified success because the IOP was controlled medically.

Cox regression analysis was performed to determine if age, race, duration of leak, prerevision IOP, time from original trabeculectomy to presentation of leak or revision surgery, or use of 5-fluorouracil injections after revision were risk factors for persistent leak or failure (complete or qualified). None of the risk factors tested was significant at P<.05. In addition, 1-way analysis of variance comparing level of IOP at 1, 3, 6, and 12 months and the last follow-up showed no significant difference in IOP control between patients who did or did not receive postoperative injections of 5-fluorouracil.

Conjunctival advancement was successful in closing late-onset bleb leaks in 24 (92%) of the 26 patients. One patient had a persistent postoperative leak after bleb revision at the same location as the original leak and remained hypotonus throughout 22 months of follow-up. This was a 51-year-old patient with myotonic dystrophy who declined further intervention other than prophylactic antibiotics, which were alternated monthly. The other patient with a persistent bleb leak at the limbus underwent treatment with pressure patching, bandage contact lens, and aqueous suppressants. After these methods failed, the postrevision leak was closed with a suture, which resulted in the elevation of IOP to 50 mm Hg. Argon laser suture lysis to a trabeculectomy flap suture was performed, after which time the leak recurred at the limbus. The patient then underwent closure of the revised trabeculectomy wound with a scleral patch graft and simultaneous glaucoma drainage implant 2 months after bleb revision. Of the 24 patients whose bleb leaks closed after conjunctival advancement, 12 had early postoperative bleb leaks that lasted from 1 day to 1 week. All early bleb leaks were noted within the first postoperative week. These early leaks occurred at the limbus in 9 patients, along the edge of a running conjunctival closure in 2 patients, and in the middle of the new filtering bleb in 1 patient. Of these 12 leaks, 7 closed with simple observation (with or without aqueous suppressants), 4 needed additional sutures to close, and 1 closed after a single application of trichloroacetic acid. No patients developed late-onset bleb leaks during the follow-up period.

Postoperative bleb appearances were evaluated and separated into "good" descriptors (large, elevated, cystic, thin, avascular) vs "bad" descriptors (small, low, flat, vascular, thick). Twenty-one patients' blebs were de-

**Figure 4.** Kaplan-Meier survival curve for complete success, defined as closure of a leak postoperatively and no further medical or surgical therapy needed, for uncontrolled intraocular pressure. Most patients (n = 9) who required medical therapy for glaucoma reinstituted within the first 6 months postoperatively.

**Figure 5.** Kaplan-Meier survival curve for qualified success, defined as closure of a leak postoperatively and no need for reoperation, for uncontrolled intraocular pressure. Two patients whose leaks never healed were immediate failures, and a third patient required reoperation for glaucoma within 1 day following revision. The only other failure occurred 2 months after revision.
Many conservative methods of closing leaks in filtering blebs have been reported, but few are consistently useful in the management of leaks in thin, avascular blebs. In the present study of 26 eyes, the indications for bleb revision were almost entirely related to severe and often sight-threatening complications of bleb leaks, including previous bleb infection, decreased visual acuity associated with ocular hypotony, corneal edema with folds, hypotony maculopathy, and persistent shallow anterior chamber. After multiple (mean, 2.2; range, 0-5) conservative methods did not close the leak, conjunctival advancement successfully repaired 24 (92%) of late-onset bleb leaks, although 5 eyes (19%) required additional sutures during the first postoperative week. Bleb appearance worsened in 21 (81%) of the eyes postoperatively, and 13 (50%) of the patients required glaucoma medications, but only 2 (8%) of the patients required reoperation for glaucoma during a mean of 20 months of follow-up. The average IOP was raised from 5.7 to 14.2 mm Hg, and 12 patients (46%) had an improvement in visual acuity of 2 or more lines. Only 2 (8%) of the patients required additional sutures to reduce the risk of postoperative hypotony. Others have reported use of autologous or donor sclera, in cases in which the scleral flap is too friable to allow suturing.

In 3 patients, we placed additional scleral flap sutures to reduce the risk of postoperative hypotony. Others have reported use of autologous or donor sclera, in cases in which the scleral flap is too friable to allow suturing.

**COMMENT**

Autologous blood injection has been used for leaking filtering blebs, and success rates of 33% to 67% have been reported, after a follow-up of 1.8 to 13.0 months. Two of our patients received blood injection before surgical revision. Although blood injection is less invasive than surgical revision, it is not without severe

Figure 6. Appearance of a functioning filtering bleb 8 months after conjunctival advancement. This patient required aqueous suppressants due to an elevated intraocular pressure.
Autologous fibrin glue has been described for the repair of eyes with thin, cystic, leaking blebs, but its preparation is cumbersome and the risk of transmitting infection is worrisome.

We were unable to find an association between complete or qualified success and age, pre-revision IOP, or type of bleb leak. Other factors that may play a role, such as bleb size and morphologic characteristics, could not be accurately assessed by our retrospective review.

Antifibrosis agents such as 5-fluorouracil and mitomycin C have been shown to be associated with a higher incidence and prevalence of bleb leaks. A significant proportion, if not most, of glaucoma filtering surgery is the repair of eyes with thin, cystic, leaking blebs, but the incidence and prevalence of bleb leaks. A significant proportion, if not most, of glaucoma filtering surgery is the repair of eyes with thin, cystic, leaking blebs.

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Corresponding author: Donald L. Budenz, MD, Bascom Palmer Eye Institute, 900 NW 17th St, Miami, FL 33138 (e-mail: dbudenz@bpei.med.miami.edu).

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