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 been successful in some patients, complications may occur. The frequency of late-onset filtering bleb leaks seems to be increasing, possibly due to the increased use of these antifibrotic agents.
**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-
cluding the trabeculectomy that led to the leak, was 1.6 ± 0.9 (range, 1-4). Prerevision bleb appearance was recorded as “thin,” “cystic,” and/or “avascular” in 23 of 26 cases. 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 (blebitis or endophthalmitis)</td>
<td>11</td>
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<tr>
<td>Hypotony maculopathy</td>
<td>4</td>
</tr>
<tr>
<td>Corneal edema with folds in the Descemet membrane</td>
<td>7</td>
</tr>
<tr>
<td>Persistent chorioidal effusion</td>
<td>3</td>
</tr>
<tr>
<td>Persistent shallow anterior chamber</td>
<td>3</td>
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</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 mecrylate tissue adhesive placed, 1 failed 2 autologous blood injections, and 2 underwent treatment with tri-chloroacetic acid. 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.
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-
scribed with bad descriptors, while 5 had good descriptors. Figure 6 is the appearance of a filtering bleb 8 months after conjunctival advancement, showing elevation and moderate vascularization. This patient was taking aqueous suppressants for elevated IOP and was a qualified success.

Visual acuity improved (2 or more lines) in 12 patients and stayed the same in the remaining 14. One patient developed decompensation of a previous corneal graft, which resulted in reduced visual acuity 7 months postoperatively. The visual acuity had been the same as the pre-revision visual acuity up until that time. Five patients had symptomatic ptosis that was not present preoperatively. There were no cases of immediate or late postoperative bleb-related infections (blebitis or endophthalmitis), suprachoroidal hemorrhage, choroidal effusions, or shallow anterior chambers after bleb revision.

**COMMENT**

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. This was surprising as only 9 patients were suspected of having reduced visual acuity as a result of their bleb leak and its sequelae.

Interpretation of previous reports on surgical bleb revision is hampered by imprecision of reporting (by modern standards), small numbers, and/or limited follow-up periods. Dunnington and Regan first described 2 patients with leaking glaucoma filtering blebs who underwent conjunctival advancement for bleb leaks. Conjunctival advancement was successful in closing both leaks, and 1 of 2 patients was receiving medical therapy for glaucoma after several years of follow-up. Sugar used a Tenon flap for bleb revision in 5 eyes; 2 eyes required more medications, 1 eye still had hypotony and cataract progression despite successful repair of the leak, and in 1 eye the flap shrank and the leak recurred. In a later report, Sugar had little success using full-thickness conjunctival advancement for repair of acutely leaking blebs (1 [14%] of 7 eyes were successful) compared with use of a Tenon flap (4 [57%] of 7 eyes were successful). Failure of conjunctival advancement usually occurred because of either retraction of the flap from the tension required for closure or scarring of the bleb with loss of function. Galin and Hung used a mattress suture technique to secure the anterior conjunctiva, and reported successful repair in 7 (88%) of 8 cases. Cohen et al used a similar method and had success in 2 of 3 cases, but the follow-up time was unspecified in each of these studies. Wilensky reviewed the outcomes of 14 leaks in 13 eyes of 12 patients; all 5 blebs that had bleb excision with conjunctival mobilization had resolution of the leak after a follow-up of 2½ to 13 months, compared with 5 (56%) of 9 leaks managed conservatively.

Our preferred method of conjunctival advancement is relatively simple. The mattress suture technique of closure is similar to that described by Galin and Hung, but rather than suturing into a sclerocorneal groove, we have found simple debridement of the corneal epithelium over the length of the conjunctival advancement to be sufficient to allow watertight healing in almost all cases. Our series includes one case in which the IOP was markedly elevated immediately after conjunctival advancement despite having no additional sutures placed in the scleral flap. Perhaps the elevated IOP in this patient was due to overly tight closure of the conjunctiva over the scleral flap. When severe scarring or large bleb size results in severe tension on the advanced conjunctiva, bleb revision with a free conjunctival autograft may be a better choice.

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.

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. However, although blood injection is less invasive than surgical revision, it is not without severe
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, prerevision IOP, or time to presentation or repair of the 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 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 incidence and prevalence of bleb leaks.

REFERENCES