Risk factors for failures of trabeculectomies performed without antimetabolites

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Abstract

Aims—To assess the risk profile for the failure of trabeculectomies in a large group of patients who were selected to be operated on without the use of antimetabolites. This was done in an effort to find subgroups of patients who may not need antimetabolites for primary procedures.

Methods—Consecutive patients scheduled for routine trabeculectomies were operated during a 4 year period and were followed up for at least 6 months postoperatively. Patients were regularly examined in the glaucoma unit and by their local ophthalmologists. Pre- and postoperative data were evaluated and success rates determined.

Results—709 eyes of 566 patients were operated on; 534 eyes of 534 patients (94.4%) were finally evaluated. The mean follow up was 27.9 (SD 13.6) months with a range of 6–62 months. Success rates for complete surgical success ranged from 59% in the best group with pigmentary dispersion syndrome to 0% in the worst group with neovascular glaucoma. Success rates of patients with POAG, pseudoexfoliation, chronic angle closure, pigmentary dispersion syndrome, and dysgenetic glaucoma were similar. Failure rates ranged from 11% in the best group (pseudoexfoliation) to 80% in the worst group (neovascular glaucoma). Failure rates were high in complicated forms of glaucoma such as traumatic (30%), buphthalmus (40%), and uveitic (50%). For repeat trabeculectomies, the failure rate was 49% (20 of 41 eyes). The mean time until failure ranged from 2.7 months (traumatic) to 15.5 months (pigmentary dispersion syndrome) and was 4.9 months for repeat trabeculectomies.

Conclusion—Trabeculectomy performed in selected groups of patients has a favourable outcome without the use of antimetabolites. It may be possible to avoid antimetabolites in these groups of patients for primary procedures.

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Trabeculectomies performed according to the first description by Cairns[1][2] or with slight modifications are the most frequently performed surgical procedure in lowering the intraocular pressure (IOP). Failures of trabeculectomies occur at a variable rate, and reports about long term success rates of this procedure are difficult to compare. At the present time, the advantage of the use of three different drugs to inhibit fibrosis at the episcleral level has been demonstrated in larger clinical studies. These drugs include steroids, 5-fluorouracil (5-FU) and mitomycin C (MMC). For the first two substances, data from 3 and 5 year follow up studies, respectively, with a prospective, randomised design are available.[3][4] There are several clinical studies showing the efficacy and advantage of MMC for both complicated and uncomplicated forms of glaucoma. While many of the studies have no control group,[5–10] some do.[11][12]

It may be accepted from clinical practice that the use of steroids has few side effects, so steroids should probably not be restricted to certain groups of patients. However, this may be the case for the antiproliferative agents 5-FU and MMC. An aspect from the most recent report of the 5-FU filtering study group[4] is of interest. The use of 5-FU was recommended for the two subgroups which included pseudophakic glaucoma and repeat trabeculectomies. For these groups, the reported success rates were markedly lower than in all other studies reported.[13][14]

Since there are only infrequent prospective studies available reporting the natural outcomes of trabeculectomies for uncomplicated cases of chronic open angle glaucoma,[15–22] it is even more difficult to determine which cases have a higher risk for early or late failures than others. At a time where different treatments for enhancing the outcome of trabeculectomies are available, there is a need to obtain information on which risk factors are important and what risk of possible side effects can be tolerated.

Since the introduction of the routine use of MMC in our department, we followed prospectively the outcome of all trabeculectomies. Eyes with a higher risk for failure and eyes with secondary forms of glaucoma were operated on with MMC, while eyes with open angle glaucoma and when serious side effects of MMC were feared, were operated on without the use of MMC. We did not use 5-FU or Molteno implants. In this communication, we report the follow up on all cases where no MMC was used in order to determine the success rates of cases of uncomplicated and complicated glaucoma from a large group of patients.

Materials and methods

We evaluated the preoperative data, course, and outcome of all trabeculectomies per-

Table 1 Study population

Characteristics	n (%)
Number of eyes operated	709 (100.0)
Number of patients	566 (100.0)
charts not found	17 (3.1)
follow up less than 6 months	15 (2.7)
Remaining eyes	670 (94.3)
Remaining patients	534 (94.4)
Patients operated on both eyes	136 (24.0)
Eyes included in this study	534
Follow up of all 534 eyes	
mean (SEM) (months)	27.9 (0.60)
range (months)	6–61

Table 2 Characteristics and diagnoses of patients

Characteristics	No of eyes n (%)
Number of eyes	534 (100)
Number of patients	534
Sex/age (years)	
Male (mean (SD))	57.3 (20.2)
range	2 weeks–88 years
Female (mean (SD))	62.2 (18.5)
range	2 weeks–91 years
Race	
White	534 (100)
Sex	
Female	258 (48)
Male	276 (52)
Type of glaucoma	
primary open angle	209 (39.1)
pseudoexfoliation	117 (21.9)
chronic angle closure	47 (8.8)
pigmentary dispersion	
syndrome	34 (6.4)
buphthalmus	25 (4.7)
dysgenetic glaucoma	21 (4.0)
uveitic glaucoma	14 (2.7)
traumatic	10 (1.9)
neovascular glaucoma	5 (0.9)
steroid induced	3 (0.5)
malignant glaucoma	3 (0.5)
pseudophakic glaucoma	2 (0.3)
aniridia	2 (0.3)
Repeat trabeculectomy	41 (7.9)

formed without MMC that were operated on by our department between January 1992 and December 1995. Informed consent was obtained from all patients before surgery. The location of all charts was monitored using a computerised system.

Patients were followed up by our glaucoma unit and/or their local ophthalmologists. Preoperative data included the type of glaucoma, the duration of the disease, the current and previous medications, current and previous intraocular pressure, visual acuity, and other ocular abnormalities. The computerised visual field tests (Humphrey field analyser, program 30-2) were obtained and repeated regularly. Patients were only eligible for the study when typical glaucomatous field defects were present. Intraocular pressures without medication were greater than 21 mm Hg in all cases. No cases of low tension glaucoma were included.

The visual field examinations were not analysed statistically since some ophthalmologists use different programs. Cataract progression had an influence on the field tests, which makes it difficult to assess them objectively. The data from the visual field testing were used and were helpful in assessing the progression of glaucoma. Follow up information included current medications, visual acuity, intraocular pressure, ocular abnormalities, surgically related complications, and the need for further surgical procedures.

For statistical evaluation, we used the data of each patient from the last complete ocular examination performed either in our department or by their local ophthalmologist. To avoid bias, only the eye operated first was evaluated from patients where both eyes were operated with sufficient data available. This reduced the total number of eyes in the study considerably, but was done in an effort to improve the statistical power of the results.

The success rate was judged using frequently used definitions.[3 4 8 10] Complete success was defined as an IOP of less than or equal to 21 mm Hg without antiglaucomatous medication; qualified success as an IOP of less than or equal to 21 mm Hg with antiglaucomatous medication. For both groups, the visual field had to be stable except for increasing defects that were not related to glaucoma. In addition, the cup/disc ratio should not have any progression along the course of the follow up period.

Failures were defined as an IOP of greater than 21 mm Hg under medication, progressive glaucomatous visual field loss combined with an increase of cupping of the optic disc regardless of the IOP, or the need for further antiglaucomatous surgical procedures.

In some patients, data from the Heidelberg retina tomograph (HRT, Heidelberg Engineering, Germany) were available and the information was thus used in monitoring the progression of the disease in concert with the above criteria.

For statistical analysis, the Wilcoxon log rank test was used in order to determine significant differences of visual acuities, IOP

Table 3 Data of the different groups operated

Diagnosis	Mean age at diagnosis of glaucoma (years)	Mean age at surgery (years)	Follow up (months) *	Time until failure (months) *	Rate of failure (%)
Primary open angle	57.9	65.7	28.7 (0.9)	13.0 (2.4)	15.0
Pseudoexfoliation	63.5	69.2	29.5 (1.3)	11.2 (2.3)	11.2
Chronic angle closure	56.2	63.6	29.3 (2.0)	8.7 (4.9)	12.8
Pigmentary dispersion syndrome	42.1	48.9	27.5 (2.5)	15.5 (7.6)	17.6
Buphthalmus	0.1	3.5	21.9 (2.8)	3.6 (1.0)	40.0
Dysgenetic glaucoma	39.6	43.1	24.9 (2.5)	10.6 (3.1)	23.8
Uveitic glaucoma	48.3	55.8	27.8 (3.0)	8.6 (3.2)	50.0
Traumatic	37.8	47.2	26.9 (4.1)	2.7 (1.2)	30.0
Neovascular glaucoma	62.3	64.6	31.0 (6.8)	12.5 (6.4)	80.0
Repeat trabeculectomy	32.0	47.2	24.7 (2.5)	4.9 (1.2)	48.8

*Mean (SEM).

Table 4 Pre- and postoperative data of the different groups

Diagnosis	VA before surgery*	VA last visit*	p Value†	IOP before surgery (mm Hg)‡	IOP last visit (mm Hg)‡	p Value†	Medications before surgery‡	Medications last visit‡	p Value†
Primary open angle	0.48	0.38	0.0001	23.9 (0.5)	16.9 (0.3)	0.0001	2.5 (0.07)	0.8 (0.07)	0.0001
Pseudoexfoliation	0.43	0.29	0.0001	26.5 (0.9)	16.2 (0.5)	0.0001	2.6 (0.10)	0.7 (0.09)	0.0001
Chronic angle closure	0.48	0.34	0.0001	28.3 (1.5)	16.7 (0.5)	0.0001	2.4 (0.14)	0.7 (0.14)	0.0001
Pigmentary dispersion syndrome	0.45	0.40	0.0001	29.1 (2.0)	15.8 (0.7)	0.0001	2.6 (0.2)	0.6 (0.16)	0.0001
Buphthalmus	0.36	0.26	0.38	27.8 (2.1)	16.0 (2.0)	0.0001	0.6 (0.21)	0.2 (0.14)	0.20
Dysgenetic glaucoma	0.69	0.61	0.42	25.8 (1.7)	17.9 (1.7)	0.007	2.3 (0.14)	1.0 (0.26)	0.0003
Uveitic glaucoma	0.18	0.07	0.058	39.2 (2.7)	20.7 (2.9)	0.002	2.6 (0.23)	1.1 (0.43)	0.007
Traumatic	0.14	0.10	0.069	32.3 (4.5)	17.8 (1.0)	0.008	2.3 (0.40)	1.0 (0.42)	0.009
Neovascular glaucoma	0.07	0.03	0.78	31.8 (3.6)	21.4 (4.2)	0.089	3.2 (0.20)	1.6 (0.40)	0.007
Repeat trabeculectomy	0.26	0.16	0.0001	29.0 (1.4)	18.8 (0.9)	0.0001	2.3 (0.20)	1.0 (0.20)	0.0001

*Data given in decimals. They were transformed to logMAR data for calculation.
†Wilcoxon signed rank test.
‡Mean (SEM).
All IOP values shown here were measured with medications.

Table 5 Success rates of the different groups

	Success		Combined	
Diagnosis	Complete* % (n)	Qualified† % (n)	success rate % (n)	Failure‡ % (n)
Primary open angle	53 (112)	32 (66)	85 (178)	15 (31)
Pseudoexfoliation	51 (60)	38 (44)	89 (104)	11 (13)
Chronic angle closure	53 (25)	34 (16)	87 (41)	13 (6)
Pigmentary dispersion syndrome	59 (20)	23 (8)	82 (28)	18 (6)
Buphthalmus	60 (15)	0 (0)	60 (15)	40 (10)
Dysgenetic glaucoma	52 (11)	17 (5)	83 (16)	17 (5)
Uveitic glaucoma	36 (5)	14 (2)	50 (7)	50 (7)
Traumatic	50 (5)	20 (2)	70 (7)	30 (3)
Neovascular glaucoma	0 (0)	20 (1)	20 (1)	80 (4)
Repeat trabeculectomy	31 (13)	20 (8)	51 (21)	49 (20)

Criteria used: *IOP <22 mm Hg and no medication; †IOP <22 mm Hg with medication; ‡IOP >21 mm Hg regardless of medication.

values, and the amount of medications between two examinations within the groups of patients. The Wilcoxon log rank test was also used in comparing different aspects between patients with a complete surgical success with those that failed. A statistically significant difference was assumed for p values lower than 0.05. Kaplan–Meier life table analysis was used to assess survival curves.

For further evaluation and statistical analysis (Tables 3, 4, 5) only such groups that included six or more eyes were evaluated. For the direct assessment of risk factors for failure, only eyes with POAG, pseudoexfoliation, and repeat trabeculectomies were evaluated (Tables 6, 7, 8), since these groups were large enough to obtain profound statistical data.

IOP was measured using Goldmann applanation tonometry. In cases with major corneal or axial and scleral abnormalities, such as buphthalmus, Perkins applanation tonometry was used. In each individual case, the same technique was applied in preoperative and follow up measurements. To determine the

number of medications used each topical medication was counted as one, if used according to the manufacturer's recommendation. Systemic treatment with carboanhydrase inhibitors counted as one point. Cases in which the maximum tolerable doses were used (three times 250 mg) counted as two points.

Visual acuities were taken using ETDRS charts and transformed into logMAR data for calculation and then retransformed into decimals.[23]

Results

We examined a total of 709 cases from 566 patients who were operated on between January 1992 and December 1995. Of these 709 trabeculectomies, we were unable to locate information from 23 (3.3%) eyes from 17 (3.1%) patients (Table 1). All cases in which the follow up was less than 6 months were excluded from the evaluation. Cases with a follow up of less than 6 months included 16 (2.3%) eyes from 15 (2.8%) patients. Reasons for short follow up were: patients who failed to appear in the department or their local ophthalmologist and so could not be monitored (n=10); patients who had emigrated (n=3); or patients who died (n=2). This left 670 eyes of 534 patients for evaluation.

A total of 276 men and 258 women were operated on. The mean age at the time of surgery of the men was 57.3 years and the mean age of the women was 62.2 years (Table 2). There was a statistical difference in the age distribution between these two groups (p <0.004; unpaired *t* test). The largest groups of patients had primary open angle glaucoma (POAG) (39.1%) or pseudoexfoliation (21.9%), while the other forms of complicated glaucoma were

Table 6 Success rates of eyes with primary open angle glaucoma (POAG)

POAG (n=209)	Complete success*	Qualified success*	Failures*	p Value†
Age (years)	64.5 (1.0)	67.2 (1.2)	66.6 (1.8)	0.31
Sex				
Female (%)	48	49	56	0.64
Male (%)	52	51	44	0.58
Amount of medications before surgery (n)	2.6 (0.1)	2.7 (0.1)	2.7 (0.2)	0.84
More than 3 years of topical treatment before surgery (%)	74	73	75	0.84
IOP before surgery (mm Hg)	24.4 (0.7)	22.4 (0.7)	25.9 (1.2)	0.27
Duration of glaucoma before surgery (years)	8.1 (0.7)	8.5 (0.7)	7.3 (1.0)	0.56
Previous argon laser trabeculoplasty (%)	35	31	43	0.39
Previous cataract surgery (%)	8	11	21	0.04
Previous goniotomy	1	1	0	0.71

*Mean (SEM).
†Comparison between complete surgical success and failures, Wilcoxon rank test.

Table 7 Success rates of eyes with pseudoexfoliation

Pseudoexfoliation glaucoma (n=117)	Complete success*	Qualified success*	Failures*	p Value†
Age (years)	68.4 (0.9)	70.9 (1.1)	68.5 (1.8)	0.17
Sex				
Female (%)	46	56	50	0.78
Male (%)	54	44	50	0.83
Amount of medications before surgery (n)	2.7 (0.2)	2.7 (0.2)	32.9 (0.5)	0.67
More than 3 years of topical treatment before surgery (%)	60	43	54	0.14
IOP before surgery (mm Hg)	26.7 (1.3)	25.4 (1.3)	28.5 (2.2)	0.54
Duration of glaucoma before surgery (years)	5.8 (1.0)	5.3 (0.9)	9.7 (3.0)	0.08
Previous argon laser trabeculoplasty (%)	31	39	54	0.11
Previous cataract surgery (%)	1.5	5	29	0.001
Previous goniotomy	0	0	0	1.0

*Mean (SEM).
†Comparison between complete surgical success and failures, Wilcoxon rank test.

less frequent. In 48 cases (7.9%), a repeat trabeculectomy was performed. Many of these patients had a diagnosis of buphthalmus (33%).

The mean age of the patients at which the diagnosis of glaucoma was made was earliest in those with buphthalmus; in many of which the diagnosis was established at or soon after birth (Table 3). In patients with trauma and dysgenetic glaucoma, the diagnosis was established relatively early with a mean age of 37.8 and 39.6 years, respectively. Patients with POAG and pseudoexfoliation tended to be somewhat older with a mean age of 57.9 and 63.5 years, respectively. The mean interval between diagnosis and surgery was 7.8 years for the patients with POAG, 5.7 years for those with pseudoexfoliation, and 7.4 for patients with chronic angle closure. This interval was shorter in patients with buphthalmus (3.4 years). Newborns with the diagnosis of buphthalmus were usually operated on within a few weeks or months, but some individuals with buphthalmus were presented at a later stage of the disease. In patients with neovascular glaucoma, the interval was 2.3 years.

The mean follow up exceeded 20 months in all groups, with 31.0 months for eyes with neovascular glaucoma being the longest. The time until failure was short in eyes with trauma (mean 2.7 months), buphthalmus (mean 3.6 months), repeat trabeculectomy (mean 4.7 months), and longer in those with POAG (mean 13.3 months) and pigmentary dispersion syndrome (mean 15.5 months). The average time until failure of the trabeculectomy was not different among the four groups—POAG, pseudoexfoliation, chronic angle closure, pigmentary dispersion syndrome, and dysgenetic glaucoma (p<0.57, unpaired *t* test). The shortest interval was in eyes with traumatic glaucoma, followed by those with buphthalmus and repeat trabeculectomy (Table 3).

The mean visual acuity deteriorated in each of the different groups (Table 4). The deterioration was significant in eyes with POAG, pseudoexfoliation, chronic angle closure, pigmentary dispersion syndrome, and repeat trabeculectomies. The average IOP was lower following surgery in each group, and the amount of medication needed was also reduced. In eyes with buphthalmus, the amount of medications before surgery was low.

Success rates for complete surgical success and failures were largely different among the groups (Table 5). Success rates were similar for eyes with POAG, pseudoexfoliation, chronic angle closure, pigmentary dispersion syndrome, and dysgenetic glaucoma and ranged from 53% to 55%. Failure rates were low and similar with a range from 11% to 17% for these groups. Failure rates were high for eyes with traumatic and uveitic glaucoma, buphthalmus, and neovascular glaucoma. For repeat trabeculectomies, the success rate was low with 31% and the rate for failures high with 48% (Fig 1).

When the large groups—POAG, pseudoexfoliation, and repeat trabeculectomy—were analysed individually, certain factors appeared to have a significant influence. In eyes with POAG (Table 6), only previous cataract surgery was a statistically significant risk factor between eyes that had a complete success and eyes with failure. The type of cataract surgery was an extracapsular procedure with a clear corneal incision without involvement of the conjunctiva. Other factors such as the amount of medications before surgery, the length of topical treatment before surgery, the duration of glaucoma before surgery, or previous argon

Table 8 Success rates of repeat trabeculectomy

Repeat trabeculectomy (n=41)	Complete success*	Qualified success	Failures*	p Value†
Age (years)	47.6 (7.9)	70.1 (1.8)	36.3 (6.9)	0.30
Sex				
Female (%)	67	89	38	0.16
Male (%)	33	11	62	0.003
Amount of medications before surgery (n)	2.1 (0.3)	2.6 (0.3)	1.8 (0.3)	0.42
More than 3 years of topical treatment before surgery (%)	85	100	52	0.11
IOP before surgery (mm Hg)	32.2 (2.8)	26.2 (3.4)	28.1 (1.9)	0.21
Duration of glaucoma before surgery (years)	9.7 (1.5)	12.4 (1.6)	9.0 (1.8)	0.78
Previous argon laser trabeculoplasty (%)	20	22	29	0.41
Previous cataract surgery (%)	20	22	25	0.53
Previous goniotomy	13	0	33	0.014

*Mean (SEM).
†Comparison between complete surgical success and failures, Wilcoxon rank test.
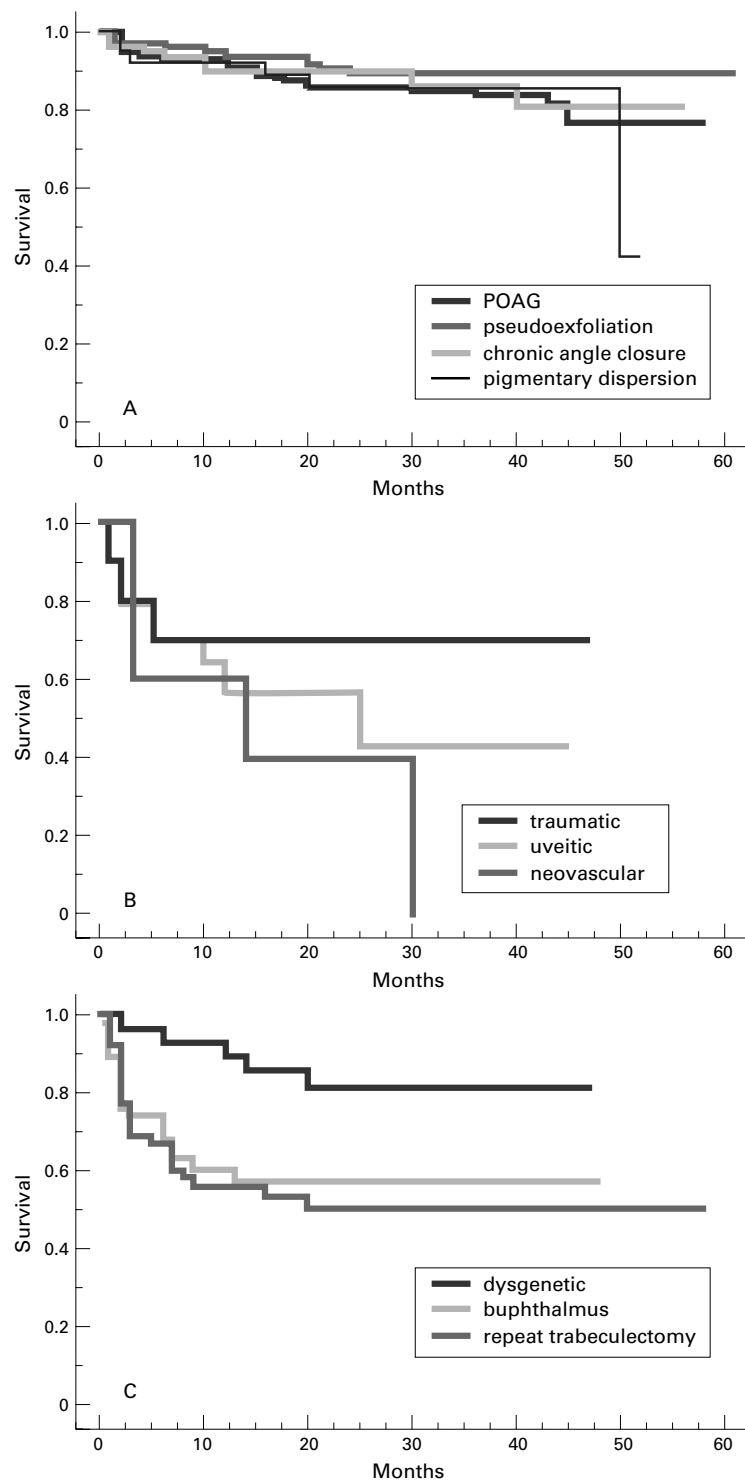
Figure 1 (A) Probability of surgical success in the subgroups with POAG, pseudoexfoliation, chronic angle closure, and pigmentary dispersion. The Kaplan–Meier survival plots showed no significant difference (p=0.45, log rank test). (B) Probability of surgical success in the subgroups with traumatic, uveitic, and neovascular glaucoma. The Kaplan–Meier survival plots showed no significant difference (p=0.30, log rank test). (C) Probability of surgical success in the subgroups with dysgenetic glaucoma, buphthalmus, and repeat trabeculectomies. The Kaplan–Meier survival plots showed a significant difference (p=0.017, log rank test).

laser trabeculoplasty (ALT) did not seem to have any influence.

In eyes with pseudoexfoliation (Table 7), previous cataract surgery also was found to be a risk factor. It appeared for eyes with repeat trabeculectomies that failures tended to be

younger than their successful counterparts (Table 8), they were predominantly male, and had undergone previous goniotomy. This may be caused by the fact that this group includes a large number of eyes with buphthalmus. The rate of previous cataract surgery was not different among the groups.

Discussion

In this study, we have shown that the intermediate term results of trabeculectomies performed without the supplemental use of antimetabolites may have good results in selected cases. Variables that influenced the success rates included, mostly, the type of glaucoma. In subgroups the age, sex, and previous surgery such as goniotomy and cataract surgery were also important factors. The number of eyes in this report with sufficient follow up was relatively high at 94.3% This is considerably higher than in most clinical studies presented on this topic so far. The surgical skills of one or only a few surgeons had no large impact, since the procedures were performed by several different glaucoma surgeons during a 4 year period.

In previous years, intermediate term and long term results of trabeculectomies were relayed for both selected and unselected groups of patients at a time when few surgical alternatives such as the use of 5-fluorouracil and MMC, trans-scleral laser therapy, viscocanalostomy, or Molteno implants were available.[15–17] [24–28] More recently, various studies focused on the issue of the use of MMC for primary procedures.[5] [29] [30] In those reports the success rates for MMC operated eyes and controls varied widely.[5] [29] These results reflect the fact that patient selection is a crucial factor in clinical studies even when the studies are well executed.

The high success rate of trabeculectomies in patients with POAG has been repeatedly noted. Cairns[2] in his early report in 1972 had a successful outcome in 78 of 80 eyes (97.5%). D'Ermo *et al* [24] found in a follow up study from 1 to 5 years a success rate of 71%. In another retrospective long term follow up study,[25] a success rate of 87% was reported in a total of 220 eyes with POAG and a follow up of up to 7 years. In a smaller study, Lewis and Phelps[31] noted only a 65% success rate of trabeculectomies in eyes with POAG followed up for 5 years. Wilson[32] reported a 7 year follow up study of 309 eyes with a success rate of 85%. Inaba[33] studied the outcome of trabeculectomy in 427 eyes in the Japanese population and had an overall success rate of 75%.

It has been repeatedly and most convincingly shown that antimetabolites are beneficial for cases with complicated forms of glaucoma.[7] [9] [34–36] However, the discussion at this time questions those cases that have fewer risk factors for the failure of trabeculectomy. Knowing about the sometimes deleterious side effects of the use of 5-FU or MMC,[37–43] it may be necessary to re-evaluate risk factors in the failures of trabeculectomies and in describing groups of patients who have a low risk for the failure of primary procedures. On the other

hand, it is also important to follow up patients with a presumed high risk for failure who were, for various reasons, operated on without antimetabolites in order to investigate their outcome.

The current study was possible because we used few therapeutic alternatives other than trabeculectomies during this time in our department. Trabeculectomies were performed either with or without MMC, and no 5-FU or Molteno implants were employed. It was therefore possible to study a large, heterogeneous group of patients who could avoid the use of MMC. Therefore, the results of this evaluation may serve to re-evaluate clinically important decisions.

Kupin *et al*[29] studied the success of trabeculectomies performed with or without MMC in eyes with POAG. With a follow up of 12 months, the success rates were 85% for MMC operated eyes compared with 56% for the controls. It is unclear why the controls had such unfavourable results when compared with our patients with POAG who had a failure rate of only 16%. Costa *et al*[42] performed a similar study and again had a low success rate in POAG eyes that were operated without MMC with only 29% after a mean follow up of 16 months. Given the high success rates for trabeculectomy in such eyes in the present report, it is difficult to understand why the success rates were so different, and why MMC, which has a higher rate of complication, should be used in primary procedures in such cases.

Interestingly, in our study success rates were almost similar in eyes with POAG, pseudoexfoliation, and chronic angle closure. A similar result was found in a study in which success rates in younger individuals were evaluated.[44] Risk factors with statistical significance in that investigation included previous cataract surgery, ALT, previous glaucoma surgery, and IOP larger than 40 mm Hg. Patients with dysgenetic glaucoma were significantly younger than those with POAG in our study, and success and failure rates were almost identical, so that we can support the finding from that study[44] that the age alone is not a general risk factor.

The best therapeutic approach for eyes with congenital glaucoma or buphthalmus is still controversial. While some authors report high success rates for trabeculotomy,[16 45] this procedure is not performed exclusively. At the current time, some glaucoma surgeons tend to favour trabeculectomies in those eyes as well.[20 46 47] In general, treatment is difficult, and the average number of surgeries in controlling the IOP in this group is around three.[48 49] Success rates range from 35% in one study[50] to 92%.[51] Because of the young age of the patients and its unknown long term side effects MMC is not yet generally acceptable in such cases. This was also the reason why our younger patients were operated on without MMC.

The results of the treatment of neovascular glaucoma with trabeculectomy again vary widely. In one report a success rate of 67% was described.[28] In a subgroup of the pilot study for 5-FU,[36] eyes were even operated on with the adjunctive use of 5-FU, and the 5 year success rate was only 28%. In that report, the median survival time was 39 months. In our study, the mean time until failure was 12.5 months with a high failure rate of 80%. It may be appropriate to use MMC primarily in those cases to improve the success rate of the first surgical intervention.

Uveitic glaucoma is a secondary form of glaucoma, which is usually associated with a poor prognosis for filtering procedures. It may be that certain factors within the aqueous humour in those eyes influence or accelerate the wound healing response at the subconjunctival and episcleral level.[52] Both Patitsas *et al*[35] and Jampel *et al*[53] operated on eyes with uveitic glaucoma with the aid of 5-FU. In the first study, 71% of the eyes were controlled after a mean follow up of 34 months, while in the latter the IOP was controlled in all 12 eyes. The mean 5-FU dosage was 58 mg and 33 mg, respectively. Prata *et al*[34] used MMC with a concentration of 0.2 mg/ml and 0.5 mg/ml. From 24 cases operated 18 (75%) were controlled after a mean follow up of 9.8 months. All failures were operated with the lower concentration of 0.2 mg/ml. In our study, a complete surgical success was only achieved in 36% of the cases, while the mean follow up was 28 months. It seems that the supplementation of trabeculectomies with antimetabolites serves to obtain markedly better results in this group of patients.

Eyes with one failed filtering procedure are obviously at high risk for consecutive similar surgical procedures. It is interesting that in the well executed, long term follow up 5-FU study[4] it was stated that caution should be exercised in the use of 5-FU in cases that usually have a good prognosis. In contrast with that report, Goldenfeld *et al*[54] used 5-FU in primary procedures on patients with POAG. The average follow up time was 20 months, and the success rate of the 5-FU operated eyes was 94% compared with 73% in the controls. Success was defined as an IOP of less than 21 mm Hg regardless of the need of antiglaucomatous medication.

The influence of chronic topical antiglaucomatous therapy on the outcome of filtering surgical procedures has long been noted. Lamping *et al*[55] retrospectively studied the outcome of 252 eyes with either full thickness procedures or trabeculectomies that had undergone surgery without previous topical therapy. The 4 year success rate for trabeculectomies was 76%, not much different from our patients with previous topical therapy. Johnson *et al*[56] studied a total of 150 eyes that had or not had a history of long term medical therapy with β blockers and found no difference in the success rates between eyes of the two different groups. Broadway *et al*[57] performed a similar study and revealed that the use of β blockers before surgery did not change the outcome significantly. However, the additional use of miotics and/or sympathomimetics did reduce the success rates. The increasing number of previous topical medications was associated with an increase of pale cells, macrophages, and

lymphocytes in the superficial conjunctival layers. In the current study, we were unable to reveal a significant difference in topically applied medications when we compared the two groups with complete success and failures.

The influence of ALT on the success of trabeculectomies has been discussed in the past. Spaeth and Baetz[58] found in a large, prospective study that ALT controls the IOP in 33% of the cases for 5 years. Johnson *et al*[56] showed that eyes with a history of previous ALT had a lower success rate following trabeculectomy after 1 year with 75% versus 91%. In our study, we did not find that those eyes with previous ALT were significantly more often associated with failures (Table 7).

In summary, we have shown that in the era where powerful antifibrotic agents are available for immediate use to the glaucoma surgeon, it is worthwhile analysing the risk profile of each case in order to determine whether their use may be beneficial or necessary. In selected groups of patients with POAG, pseudoexfoliation, chronic angle closure, and dysgenetic glaucoma, success rates are encouragingly high without the use of any additional substances. Success rates were well below 50% in other groups of secondary glaucoma such as repeat trabeculectomies, uveitic, traumatic, and neovascular glaucoma, so that the initial use of adjunctive medication may be the correct choice.

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