ORIGINAL ARTICLE

Trabeculectomy Outcomes in a Malaysian General Hospital

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Summary

A retrospective study was conducted at the Hospital Sultanah Aminah Johor Bahru to determine the outcome of trabeculectomy surgeries over a period of 4 years. One hundred and two eyes were followed up to a maximum of 63 months (mean 34.2 months). The 2-year survival rates for plain trabeculectomies, 5-Fluorouracil augmented trabeculectomies and Mitomycin-C augmented trabeculectomies were 52.9%, 27.3% and 60.5% respectively. The commonest complications noted were cataract formation (25%) and hyphaema (11%). Mitomycin-C induced complications were rarely seen. At last follow-up, 54% of eyes had intraocular pressures below 21mmHg without medication, while 34% of eyes had intraocular pressures below 21mmHg with medication. Vitreous at the trabeculectomy site was a statistically significant predictor of operative failure.

Key Words: Glaucoma, Trabeculectomy, Antimetabolites, 5-Fluorouracil, Mitomycin-C, Outcome, Success Rate, Asian, Malaysia

Introduction

Trabeculectomy is the standard filtration operation for the treatment of raised intraocular pressure, which is the main risk factor for developing glaucomatous optic neuropathy. The purpose of this study was to determine the outcome of consecutive plain, unaugmented trabeculectomy filtration surgeries as well as antimetabolite-augmented trabeculectomies performed on Malaysian citizens at the Hospital Sultanah Aminah, Johor Bahru, West Malaysia, over a period of 4 years.

A previous Malaysian trabeculectomy outcome study [1] carried out between 1989 and 1992, before the advent of antimetabolite augmentation for trabeculectomy, indicated that Malaysian eyes were at high risk of failure if plain unaugmented trabeculectomy was performed. Our study attempts to ascertain if antimetabolites increase the success rate of trabeculectomies in a Malaysian population.

It is known that trabeculectomy success rates vary between racial groups (the best outcomes have been observed in Caucasian populations, in which success rates of up to 84% have been reported[2], while worse outcomes have been observed in blacks and Afro-Caribbean peoples[3,4]), age groups (younger patients have worse outcomes[4-6]) and

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type of glaucoma (secondary and inflammatory glaucomas faring worse[7-9]).

Two antimetabolites, 5-Fluorouracil (5FU) and Mitomycin-C (MMC) are routinely used as adjunctive treatment perioperatively during trabeculectomy, in an effort to prevent subconjunctival fibrosis, which is the main cause of postoperative filtration failure. 5FU is a pyrimidine analogue that prevents DNA synthesis in fibroblasts by competitive inhibition of thymidylate synthetase; it only affects actively dividing cells. It has shown promise in trabeculectomy outcome studies[10-13]. MMC[14] is a non-cell-cycle specific alkylating agent isolated from *Streptomyces caespitosus*, which has been shown to decrease the risk of bleb failure after trabeculectomy [15-17].

The study was carried out at the Hospital Sultanah Aminah, Johor Bahru (HSAJB), which is a 989 bed general hospital serving the district of Johor Bahru[18]. HSAJB is also the tertiary referral centre for the state of Johor (population 2,740,625[19]) in West Malaysia. The Eye Department in HSAJB is the second largest in the Government sector in Malaysia.

Materials and Methods

A retrospective study was done on all Malaysian citizens presenting for trabeculectomy filtration surgery, with and without antimetabolite augmentation, at the Eye Department in HSAJB over a four-year period from 1st January 1997 until 31st December 2000.

A Cairns-type trabeculectomy[20,21] was performed in all cases. A fornix-based conjunctival flap was first fashioned, following which a triangular one-third-thickness scleral flap in the shape of an isosceles triangle with its base at the limbus, measuring 4 mm in height and 4 mm at its base, was dissected until clear cornea was reached. A rectangular corneal opening was then dissected at the base of the scleral flap to enter the anterior chamber; a peripheral iridectomy was then performed. The scleral flap was closed with three interrupted 10/0 nylon sutures, after which the conjunctival flap was closed with interrupted 10/0 nylon sutures. A subconjunctival injection of dexamethasone 4mg and gentamicin 20mg was given at the conclusion of surgery. All antiglaucoma medications to the operated eye were stopped postoperatively. Postoperative therapy to the operated eye consisted of G Betnesol-N instilled every 2 hours initially and this was tailed off over a period of 10 weeks. Other therapy was instituted as necessary depending on the post-operative situation.

If antimetabolites were used, cellulose sponges soaked either in 5FU 50mg/ml or MMC 0.04 mg/ml was placed under the dissected conjunctival flap for a total of 3 minutes. At the end of 3 minutes, the sponges were removed and any remaining antimetabolite was carefully washed away with 50 millilitres of normal saline, following which scleral flap dissection, and the rest of the operative procedure as detailed above, was completed.

Patient details recorded for this study included name, age, race, sex, date and nature of operation undertaken, district of origin, indications for operation, type of anaesthesia used, pre-operative diagnosis with gonioscopy, date of first presentation, and date of last visit. The details of ocular examination at presentation, including Snellen acuity, intraocular pressures (IOPs) by Goldmann tonometry and optic nerve cup-disc ratio (CDR) were recorded. IOPs immediately prior to operation were noted, as was the highest IOP recorded preoperatively. The number of pre-operative and post-operative medications used was also recorded. The IOPs, visual acuities and CDRs were recorded for subsequent postoperative visits. The longest period of follow-up obtained was 63 months. The surgeries were performed by ophthalmology specialists, apart from 1 eye where operation was performed by a trainee in ophthalmology.

Patients who had combined cataract and filtration surgeries or previous filtration surgery were

excluded from the study. Of the 107 eyes of 97 patients meeting inclusion criteria, adequate follow-up was obtained on 102 eyes (95.3%) of 92 patients. Four patients defaulted immediately after discharge from hospital and could not be traced despite intensive attempts to contact them, and 1 patient who was contacted refused follow-up at hospital or a home visit. Eight patients out of the 92 studied (8.7%) died during the course of follow-up of causes unrelated to their trabeculectomy surgery. Except for 1 patient, their trabeculectomies were all functioning at their last assessment visits prior to their deaths.

The results of the surgeries were graded as follows:

1. Complete Success (CS): IOP below 21 mmHg without medication
2. Qualified Success (QS): IOP below 21 mmHg with medication
3. Complete Failure (CF): IOP at or above 21 mmHg despite additional medication; eyes requiring additional glaucoma surgery; eyes with no perception of light; eyes becoming phthisical.

There is no formal glaucoma registry at the Hospital Sultanah Aminah, but based on the quantum of glaucoma medications prescribed per month, the Eye Department has approximately 1,200 patients with treated glaucoma under regular follow-up.

The Mann-Whitney U test was used to compare non-parametric means. Survival was analysed using the Kaplan-Meier product limit method. The chi-square test was done to determine differences between the survival curves. The log-rank test was used to analyse independent variables influencing survival times. Statistical significance was defined as a probability (p) value of less than 0.05.

Results

A total of 102 surgeries performed on 92 patients were studied. Ten patients had bilateral surgery. Forty-four of the surgeries involved the right eye (43%) and 58 involved the left eye (57%).

Age

Table I illustrates the age distribution of the patients. For the plain trabeculectomy cohort, the mean age at operation was 62.8 (range 18-90) years. For the augmented trabeculectomy cohort, the mean age was 53.4 (range 12-78) years. This difference in mean age is statistically significant (p=0.0008). Younger age is regarded as a risk factor for surgery failure [4,5], and thus younger patients were more likely to be assigned to have antimetabolite-augmented trabeculectomy.

Most of the patients (95.7%) requiring plain trabeculectomy filtration surgery were between 41-80 years old, while 81.8% of the augmented trabeculectomy cohort fell into this age range.

Sex and race

The sex and race distribution of the patients are shown in Table II.

Trabeculectomies were performed for 72 male eyes (70.6%) and 30 female eyes (29.4%). Surgery was performed on 48 Malay eyes (47%), 39 Chinese eyes (38%) and 15 Indian eyes (15%). The Johor state Malaysian population has a racial distribution of 57.1% Malays, 35.4 % Chinese, 6.9% Indians and 0.6% others[19].

Type of surgery

Table III summarises the types of trabeculectomies performed. There were 47 eyes in the plain trabeculectomy group. There were 11 eyes in the 5FU-trabeculectomy group and a further 44 eyes in the MMC-trabeculectomy group, giving a total of 55 antimetabolite-augmented trabeculectomies.

District of origin

Sixty-two patients originated from Johor Bahru district, 7 from Kota Tinggi district, 7 from Pontian

district, 6 from Batu Pahat district, 5 from Mersing district, 3 from Kluang district and 2 from Segamat district. Of the 8 districts in Johor state, only Muar district was not represented, as there is an Eye Department situated at Muar Hospital. There were only 2 patients from Segamat district as this district is also covered by Muar Hospital.

Indication for operation

The commonest indication for operation was raised IOP which failed to lower to an appropriate target pressure despite medical and laser therapy (n=90; 88%). A less common reason was increasing optic disc cupping and field loss despite IOP being less than 21 mmHg on maximal tolerated medical therapy (n=12; 12%). Non-compliance with medication was not included as an indication for operation, as this determination is too subjective, and in any case results in raised IOPs.

Type of anaesthesia used

The majority of the surgeries were performed under local anaesthesia (n=92; 90%), with a much lesser number (n=10; 10%) performed under general anaesthesia. The reasons for operation under general anaesthesia were young age (n=8) and uncooperative psychiatric or demented patients (n=2). One patient experienced a retrobulbar haemorrhage during administration of local anaesthetic, following which surgery was postponed until the haemorrhage resolved. That patient's operation was a Qualified Success. There were no other significant complications from either type of anaesthetic.

Pre-operative diagnosis

The pre-operative diagnoses are recorded in Table IV. The glaucoma types fall into 4 main groups in the plain trabeculectomy cohort, with Primary Open Angle Glaucoma (POAG), Primary Angle-Closure Glaucoma (PACG), Chronic Angle-Closure Glaucoma (CACG) and Pseudoexfoliation Glaucoma (PXEG) accounting for 94% of all operated eyes. Primary glaucomas account for 83% of operated eyes.

In the augmented trabeculectomy cohort, 74% of the operated eyes had primary glaucomas. No PXEG patients were assigned to the augmented trabeculectomy cohort. The uncommon secondary glaucomas with a much higher risk of trabeculectomy failure, such as angle recession glaucoma, pseudophakic glaucoma and inflammatory glaucoma, were assigned to the antimetabolite group. This follows usual guidelines for antimetabolite use. No Indian patient had surgery for angle-closure glaucoma or angle recession glaucoma, while no Chinese patient suffered from PXEG severely enough to warrant operation.

Pre and post-operative follow-up time

The global follow-up time before surgery was performed was 19.6 months (range 3 days to 324 months). If a patient had PACG, the mean follow-up mean time before operation was 8.4 months, while the CACG cohort waited 15.6 months. POAG patients waited 26.1 months before operation. These differences did not reach statistical significance. Twelve patients (4 with POAG, 4 with PACG, 2 each with CACG and PXEG) were operated on within a month of presentation. The global mean follow-up time postoperatively was 34.2 (range 1-63) months.

Pre and postoperative IOP measurements

The highest pre-operative IOP readings recorded for the plain trabeculectomy group had a mean value of 45.7 (range 18-70) mmHg. This IOP had been reduced by medical treatment to a mean of 23.5 (range 6-57) mmHg prior to operation. The last follow-up IOP readings recorded had a mean value of 13.7 (range 8-20) mmHg if the trabeculectomies were functioning (CS subgroup), and 19.3 (range 8-50) mmHg if they were in the QS and CF subgroups.

The highest pre-operative IOP readings recorded in the 5FU and MMC trabeculectomy groups were 31.6 (range 17-41) mmHg and 41.7 (range 18-70) mmHg respectively. These reduced after treatment to 19.7 (range 8-28) mmHg and 24.6 (range 10-55) mmHg respectively, prior to surgery. The last follow-up IOP readings recorded for 5FU trabeculectomies were 19 mmHg (no range) in the CS subgroup, and 16.6 (range 10-20) mmHg if they were in the QS and CF subgroups. The last follow-up IOP readings for the MMC trabeculectomy cohort were 13.9mmHg (range 6-20) mmHg if in the CS subgroup and 19.8 (range 10-58) mmHg if in the QS and CF subgroups.

Number of medications needed pre and postoperatively

The type of medical therapy instituted to control IOP was dictated by the availability of medications at HSAJB, which are free of charge. Patients were usually commenced on a topical beta-blocker such as timolol or betaxolol as a first line therapy, followed by pilocarpine. When a third topical medication and/or oral acetazolamide were added, this became a prelude to surgery. In recent years, the availability of topical latanoprost and dorzolamide has allowed a minority who are able to afford these medications (sourced privately) to have these added to the treatment armamentarium.

The mean number of different medications prescribed to patients before operation was 2.53 (range 1-4) for the plain trabeculectomy group, declining to a mean number of 0.70 (range 0-3) postoperatively (p=0.0000). The mean number of different medications prescribed to patients before 5FU trabeculectomies and MMC-trabeculectomies were 2.54 (range 2-3) and 2.20 (range 2-3) respectively. These numbers postoperatively declined to means of 1.73 (range 0-3, p<0.001) and 0.75 (range 0-3, p=0.0000) respectively.

Cup-disc ratios

The mean pre-operative CDR in the plain trabeculectomy cohort was 0.73 (range 0.3-1.0). The mean post-operative CDR in the plain trabeculectomy cohort at the last presentation to the Eye Department was 0.82 (range 0.3-1.0). This increase in optic disc cupping was statistically significant (p=0.018).

In the 5FU-trabeculectomy cohort, the mean pre-operative CDR was 0.71 (range 0.4-0.9), worsening to a postoperative CDR of 0.82 (range 0.5-1.0). This increase in optic disc cupping was not statistically significant (p<0.10). In the MMC-trabeculectomy cohort, the mean pre-operative CDR was 0.63 (range 0.2-1.0). The CDR in this cohort increased at last follow-up to 0.68 (range 0.2-1.0). This increase in optic disc cupping was statistically significant (p=0.000).

Five eyes were listed as having a CDR of 1.0 preoperatively; this number increased to 16 eyes by the last follow-up. Of these eyes, only 3 had central Snellen visual acuities better than 3/60.

While there was considerable inter-observer variation in the assessment of CDR, the ratios recorded appeared to be consistent through time.

Snellen visual acuity

At last follow-up, 38 eyes (37%) had better Snellen visual acuity than pre-operatively, 27 eyes (27%) had the same acuity, and 37 eyes (36%) had worse visual acuity readings. Of these, 13 eyes (13%) lost 2 or more Snellen lines of acuity.

Survival analysis

The survival curves for the three types of trabeculectomies are shown in Figures 1 and 2.

In the Kaplan-Meier analysis, only those operated eyes with IOPs below 21mmHg without medication are counted as successes, namely the CS subgroup. There was no significant difference in survival times between plain trabeculectomies and MMC-trabeculectomies (p=0.44). However, there was a statistically significant difference in the survival between MMC-trabeculectomies and 5FU-trabeculectomies (p= 0.03). Only 12 of the

functioning trabeculectomies did not have a follow-up of at least two full years. Thus, 2-year survival rates were calculated, as this gave the best balance between validity and bias.

Twenty-two of the functioning trabeculectomies did not complete follow-up to a full 3 years; the proportion grew for the 4 and 5 year marks, to the extent that the confidence intervals at the 4 and 5-year marks did not allow for reliable analysis. The 2-year and 3-year survival rates are given in Table V.

At last follow-up, 55 eyes (54%) had a result of CS, 35 eyes (34%) had a result of QS, and 12 eyes (12%) had a result of CF. A proportion of patients in the QS group were restarted on antiglaucoma therapy although their IOPs were below 21mmHg at the time of resuming therapy, as it was considered that these IOPs were still higher than their appropriate target pressures.

There were 12 eyes (12%) in the CF group. Four eyes required further trabeculectomy surgery. Five eyes had IOPs higher than 21mmHg even with additional medical treatment.

Three eyes with advanced glaucoma pre-operatively proceeded to lose light perception and remaining visual field (snuffout syndrome). Two of these had plain trabeculectomies performed, and one had an MMC trabeculectomy performed. Preoperative visual acuity was recorded as Counting Fingers in 2 cases, and Hand Movements in the last case.

Analysis of other independent variables

Using log-rank testing, it was determined that age, sex, race, pre-operative diagnosis, preoperative follow-up interval and the number of medications used preoperatively had no statistically significant influence on trabeculectomy survival rates.

Complications

The commonest complications encountered are summarised in Table VI.

In all, 53 eyes (52%) had some form of notable complication listed in the postoperative notes. Twenty-one (45%) of the plain trabeculectomy eyes, 7 (63%) of the 5FU-trabeculectomy eyes and 24 (55%) of the MMC-trabeculectomy eyes suffered some form of complication postoperatively. Other studies have quoted complication rates ranging from 40% to 77% [1,22,23].

A total of 25 eyes (25%) developed significant cataracts, for which 19 underwent surgery. Cataracts developed in 9 (19%) of the plain trabeculectomy cohort, 10 (23%) of the MMC-trabeculectomy cohort, and 6 (54.5%) of the 5FU-trabeculectomy cohort. The incidence of cataracts in other studies ranges from 9.8% to 35% [1,2,8,9,23,24,25].

The mean time interval between trabeculectomy and lens extraction was 24.1 months (range 0.5-55 months). Cataract extraction was performed in 2 eyes within 1 month or less of the trabeculectomy because anterior chamber reformation was not possible by any other means. Cataract extraction did not affect the survival rate of trabeculectomy surgery in this study. This contrasts with other studies, which showed that performing cataract surgery after trabeculectomy raised IOPs, especially if such complications as vitreous loss occurred [26]. High postoperative IOP may further damage compromised optic nerves [27-29]. Fifty-four percent of 5FU-trabeculectomy eyes developed cataracts in this study, but this could be artefactual because this cohort had the longest mean follow-up time (44 months) of all the subgroups, and senile cataract formation increases with time.

Hyphaema was noted on the first postoperative day in 13% of the eyes, as compared with incidences of 7-53% quoted in other studies [1,2,8,9,23,24,25]. All 5 eyes with leaking trabeculectomy blebs required bleb resuturing. Bleb needling was

performed in 1 eye. Retrobulbar haemorrhage following injection of local anaesthetic was observed in 1 eye. Three cases of total field loss (snuffout syndrome) were seen in patients with preoperative subtotal field loss and cup-disc ratios of 0.9.

Automated anterior vitrectomy was performed in 3 eyes (one with aphakic glaucoma, one with PXEG and one with PACG) in which vitreous was present at the trabeculectomy site. All three trabeculectomies failed, with a mean time to failure of 177 days. No eyes developed persistent corneal epithelial erosions, blebitis or endophthalmitis as a result of antimetabolite use. No complications resulting from prolonged hypotony were observed in this study.

The log-rank test was used to compare the survival probability of trabeculectomised eyes with and without the presence of complications. It was determined that the difference in survival times were not statistically significant, except in the case of vitreous presenting at the trabeculectomy site, which had a statistically significant association with trabeculectomy failure (p=0.005).

Table I: Age Distribution of Patients

	Plain Trabeculectomy			Augmented Trabeculectomy			
	Malay	Chinese	Indian	Malay	Chinese	Indian	
Age Range (Years)							**Total**
0-20	1	0	0	3	0	0	4
21-40	0	0	0	3	4	0	7
41-60	6	8	1	10	8	3	36
61-80	15	7	8	9	12	3	54
81-100	1	0	0	0	0	0	1
Total	**23**	**15**	**9**	**25**	**24**	**6**	**102**

Table II: Sex And Race Distribution Of Patients

	Plain Trabeculectomy			Augmented Trabeculectomy		
	Malay	Chinese	Indian	Malay	Chinese	Indian
Male	15	9	7	18	19	4
Female	8	6	2	7	5	2
Total	**23**	**15**	**9**	**25**	**24**	**6**

Table III: Type Of Surgery Performed

Type of Surgery	1997	1998	1999	2000
Plain Trabeculectomy	16	6	12	13
5FU-Trabeculectomy	9	1	0	1
MMC-Trabeculectomy	11	14	12	7
Total	**36**	**21**	**24**	**21**

Table IV: Pre-Operative Diagnoses

	Plain Trabeculectomy			Augmented Trabeculectomy			
	Malay	Chinese	Indian	Malay	Chinese	Indian	Total
Diagnosis							
POAG	6	6	5	8	15	3	43
PACG	7	4	0	4	3	0	18
CACG	4	5	0	2	5	0	16
PXEG	4	0	3	0	0	0	7
Aphakic Glaucoma	0	0	1	2	0	1	4
Juvenile Glaucoma	1	0	0	2	0	0	3
Low Tension Glaucoma	1	0	0	0	0	2	3
Angle Recession Glaucoma	0	0	0	4	1	0	5
Pseudophakic Glaucoma	0	0	0	2	0	0	2
Posner-Schlossman Syndrome	0	0	0	1	0	0	1
Total	**23**	**15**	**9**	**25**	**24**	**6**	**102**

Table V: Survival Rates For Trabeculectomies

	2-year survival	3-year survival
Type of Operation		
Plain trabeculectomy	52.9%	45.0%
5FU-Trabeculectomy	27.3%	18.2%
MMC-Trabeculectomy	60.5%	49.9%

Table VI: Complications Of Trabeculectomy Surgery

	Type of trabeculectomy			
	Plain (n=47)	5FU (n=11)	MMC (n=44)	Total (n=102)
Complication				
Cataract Formation	9	6	10	25 (25%)
Hyphaema	5	1	5	11 (11%)
Flat Anterior Chamber	4	2	4	10 (10%)
Leaking bleb	1	1	3	5 (5%)
Choroidal Detachment	3	0	1	4 (4%)
Snuffout syndrome	2	0	1	3 (3%)
Vitreous In Wound	2	0	1	3 (3%)

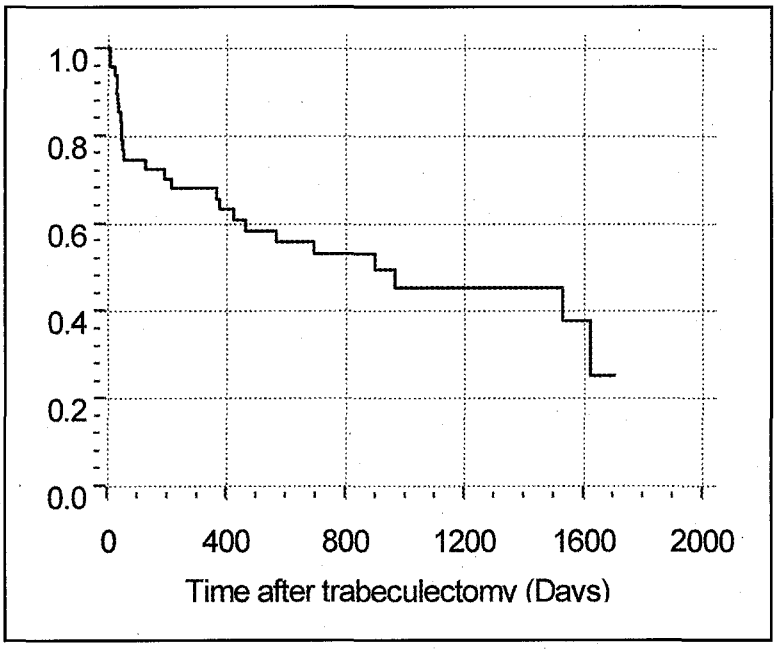

Fig 1: Survival probability (Kaplan-Meier plot) after plain trabeculectomy

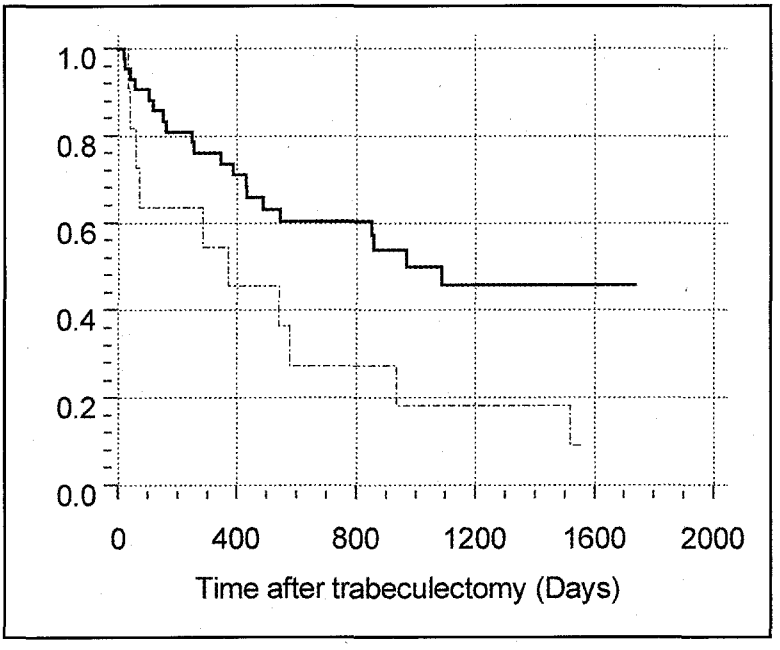

Fig 2: Survival probability (Kaplan-Meier plot) after MMC trabeculectomy (bold line) and 5FU trabeculectomy (fine line)

Discussion

Glaucoma is the second-commonest cause of untreatable blindness worldwide; 66.7 million people are estimated to suffer from glaucoma with 6.7 million people bilaterally blind from the disease. East Asians account for half the world's glaucoma patients[30,31]. Glaucoma is the fourth commonest cause of blindness in Malaysia[32]. In a study conducted at Hospital Kuala Lumpur between 1986-1990, the incidence of glaucoma in new Eye Clinic attendees was POAG 1.33%, PACG 0.86%, normal and low tension glaucoma 0.19%, infantile glaucoma 0.04% and secondary glaucoma 0.45% [33].

Studies in Singapore[34] determined that PACG is three times more common than POAG in their population. A higher incidence of PACG has also been found in studies done in other Asian countries[32]. A Singapore population survey on 2000 Chinese subjects aged 40 years and older determined that glaucoma was the leading cause of untreatable blindness (60%) in that population and had a prevalence rate of 3.2% there [35].

Afro-Carribean patients are traditionally thought to be the racial group most at risk of trabeculectomy failure[3], with success rates of up to 67% for trabeculectomies, in comparison with Caucasian populations, which have success rates of up to 84% [2,8,9,23,24,25].

However, recent research published in Malaysia[1] and Singapore [6] determined success rates for plain trabeculectomy for primary glaucomas at 43-62% after 2 years, and 43% at last follow-up (mean followup of 39 months), respectively. Another Singapore study determined success rates for plain trabeculectomies as being 54% after 12 months and 36% after three years [36].

Our study indicates successful plain trabeculectomy outcomes of 52.9% after 2 years, and 45.0% after 3 years follow-up. The corresponding rates for MMC trabeculectomies are 60.5% and 49.9% respectively, which occurs in a cohort at higher risk of bleb failure than in the plain trabeculectomy group, due to younger age and more patients with secondary glaucoma. Higher-risk cases assigned 5FU-augmentation failed early in follow-up, and the authors do not recommend the use of 5FU in a Malaysian population. This contrasts with a previous Singapore study, which gives encouraging results for 5FU use[36], with success rate of 66% after 3 years. Even then, this rate only compares with the 67% unaugmented success rate achieved in blacks, which is considered low.

Reasons for the comparatively low success rates obtained in our study from antimetabolite use may include the 3-minute exposure used compared with 5-minute exposures that have been used in other centres. However, the more devastating complications of antimetabolite use such as corneal toxicity[37], endophthalmitis, avascular leaking blebs, blebitis and persistent hypotony [38,39] were not seen in our study. The major complications encountered include cataract formation[23] and snuff-out syndrome, which is a major cause of sudden blindness where there is preexisting severe glaucomatous field loss, especially where such field loss already splits fixation[40,41].

Glaucoma, or more properly the glaucomas, is a field in which the definitions and treatment endpoints are still evolving. Glaucoma was defined as a condition in which elevated IOP (usually taken as IOP above 21mmHg) caused a characteristic arcuate scotoma and optic disc cupping. The definition of glaucoma has changed, to reflect that IOP no longer has absolute primacy; glaucoma now refers to a common progressive form of optic neuropathy associated with a characteristic cupping of the optic nerve head and characteristic pattern of visual field loss, with the main causative factor being raised IOPs. Other pressure-independent factors include genetics (associated with familial tendency and race), systemic hypertension, myopia, low ocular perfusion pressure and vascular dysregulation [42,43]. Diabetes mellitus was not a risk factor [44]. The final

common pathway is the selective death of retinal ganglion cells by apoptosis[45]. The larger retinal ganglion cells seem more prone to cell injury and death.

Despite this new understanding, IOP still remains the only risk factor readily influenced by medical, surgical or laser intervention. There is overwhelming evidence to conclude that the lower the IOP in a glaucoma patient, the better his or her chances are of retaining visual function. The aim is now to reach a sufficiently low "Target Pressure" where it is hoped no further retinal ganglion cell death or visual field deterioration will occur as a result of raised IOP, although nerve cell degeneration as a result of normal aging changes will continue.

There was a vogue in Western countries, where trabeculectomies seem remarkably successful compared to results from black or Asian eyes, to suggest early trabeculectomy[46,47] as a primary treatment option for POAG, more so as some studies suggested that prolonged topical treatment could itself cause a reduction in trabeculectomy success rates[48,49]. It was also found, in Western studies, that surgery reduced IOPs more effectively than medication. However, from the authors' experience, Malaysian patients are more reluctant to choose surgery as a primary treatment option, preferring to be treated medically as long as possible. This may be a reasonable decision in view of the apparently lower trabeculectomy success rates in Asians. The progression of visual field loss is also significantly slower in Asians with normal tension glaucoma compared with other races [50]; it is, however, difficult to comment if this racial protective effect extends to the other commoner forms of glaucoma.

The choice of topical medications available for the treatment of glaucoma has increased dramatically since the mid-1990s. The advent of highly effective topical carbonic anhydrase inhibitors (dorzolamide and brinzolamide), alpha-2 agonists (brimonidine), topical prostaglandin analogues (latanoprost and travoprost) and synthetic prostamide analogues (bimatoprost) has revolutionised medical therapy for glaucoma. Ophthalmologists are no longer restricted to only using anticholinergics (pilocarpine), beta-blockers (e.g. timolol and betaxalol) and oral carbonic anhydrase inhibitors (acetazolamide) in the treatment of glaucoma.

However, medical treatment, especially with the newer drugs, comes at a price; for example, the combined therapy of pilocarpine, timolol and latanoprost costs RM140.00 (USD 37.00) monthly. This is beyond the financial reach of most private citizens and Asian governments.

This has to be balanced with the cost of a trabeculectomy, which in terms of consumables costs only a minimal amount, and, from our results, significantly lowers the number of medications needed postoperatively.

In the context of Malaysia, trabeculectomy success rates are not optimal, and seem even lower than those for Afro-Caribbeans (which were previously thought to be in the worst-prognosis group). There are a significant number of eyes with angle-closure glaucoma in our study, a group associated with a lower trabeculectomy survival rate[1,51].

Ongoing research[52] may well prove that cataract extraction[53,54] is an even better choice for IOP control than trabeculectomy for angle-closure glaucoma patients, but the results from randomised double-blind studies will not be available for years.

Modern technology is providing more choices for the nonsurgical treatment of raised IOP, with new options in neuroprotection [55] for the population segment that can afford its cost. As yet unresolved is how, in fact, to screen and reach the bulk of glaucomatous individuals who remain undiagnosed, and are thus destined to present in an advanced stage of optic nerve head degeneration due to this often-silent thief of vision.

Local populations are different in their response to glaucoma surgery; to fulfil its promise of high success rates, trabeculectomy surgery will have to

be further modified for our population, just as current methods of laser iridotomy and argon laser iridoplasty have been modified to treat Asian eyes with greater efficiency. It must be remembered that trabeculectomies were used to treat a specific cohort of our patients who were not served well by medical therapy alone; IOPs of below 21 mmHg were achieved in 88% of our patients at last follow-up, although in 34%, this was achieved only with added medication. Without surgical intervention, many of these 88% would have experienced early blindness and other ocular morbidity.

In conclusion, Malaysian trabeculectomy success rates appear to be lower than those of Caucasian populations. As such, other primary modalities of treatment for glaucoma should be explored before trabeculectomy is considered.

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