ORIGINAL ARTICLE

The Outcome of Trabeculectomy for Primary Glaucoma in Adult Patients in UKM

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Summary

A clinical audit was conducted for a 4-year period at the Universiti Kebangsaan Malaysia (UKM) Ophthalmology Department in which 61 eyes of adult patients with primary glaucoma underwent trabeculectomies without antimetabolites. At a 2-year follow-up duration, successful trabeculectomies as defined by intraocular pressure below 20 mm Hg without additional glaucoma medication were 62% for primary open-angle glaucoma, 48% for primary acute angle-closure glaucoma and 43% for chronic angle-closure glaucoma. 50.8% of eyes were without complications while 49.2% had complications. Shallow anterior chamber (22.9%) and hyphaema (19.7%) were the two commonest complications.

Key Words: Trabeculectomy, Glaucoma

Introduction

Glaucoma is an ocular disease in which increased intraocular pressure may cause optic atrophy with excavation of the optic disc and characteristic loss of visual field. Glaucoma is customarily divided into open-angle and closed-angle types. If the cause is evident, glaucoma is designated as secondary, but if the cause is unknown, it is designated as primary.

In open-angle glaucoma the aqueous humour has free access to the trabecular meshwork, which is the drainage apparatus in the anterior chamber angle. However, there is impairment of aqueous humour drainage through the trabecular meshwork itself, and this results in increased intraocular pressure.

In closed-angle glaucoma the root of the iris is in apposition to the trabecular meshwork, and this prevents aqueous humour leaving the eye. Primary closed-angle glaucoma can be sub-classified into acute and chronic types based on the clinical presentation. Acute angle-closure glaucoma is characterised by symptoms and signs related to a sudden onset of raised intraocular pressure. Chronic angle-closure glaucoma presents with an insidious and gradual increase in intraocular pressure.

In the management of glaucoma patients, one of the aims of treatment is to lower the intraocular pressure below a level that is likely to produce damage to the optic nerve but not to reduce it so low as to cause problems with hypotony. In general the lowest intraocular pressure well tolerated by the eye is 6 to 8 mm Hg.[1] Below this level, cataracts, choroidal elevation, macular swelling, optic disc swelling, and refractive variations occur. Currently, the aim is to lower the intraocular pressure below 20 mm Hg in order to stop progressive damage[1].

Generally, medical treatment is the first line of management. Medical modes of treatment involve the use of: 1) beta-adrenergic antagonists, such as timolol, levobulonol, and betaxalol; 2) adrenergic agonists, such as epinephrine and dipivefrin; 3) cholinergic agonists such as pilocarpine, echothiophate, demecarium bromide, and carbachol; 4) carbonic anhydrase

inhibitors, such as acetazolamide, methazolamide; and 5) hyperosmotic agents, such as mannitol and glycerol.

Generally, surgical treatment is advocated when glaucoma is uncontrolled despite maximal medical therapy or when the patient is non-compliant or is unable to tolerate medical treatment. However, in certain centres, surgical management of glaucoma is instituted as a primary treatment.

Trabeculectomy is the commonest surgical procedure done for glaucoma and has been one of the standard methods of surgical treatment for glaucoma since its introduction by Cairns in 1968[2]. It has gained wide acceptance because of its relatively higher rate of success compared to other similar surgical procedures and its relatively low rate of serious complications.

Trabeculectomy has been performed by ophthalmologists in this country for at least the past 15 years. However, till now there are no available statistics regarding the outcome of trabeculectomies done in this country with regards to its success rate and the type and frequency of its complications. This information would be useful in the improvement of care for glaucoma patients. It is with this aim that this study has been undertaken.

The objective of this study was to review the trabeculectomies done in the Ophthalmology Department, Faculty of Medicine, Universiti Kebangsaan Malaysia (U.K.M.) over a 4-year period of time.

Materials and Methods

This study is a clinical audit of all adult patients with primary glaucoma who underwent trabeculectomy in the Ophthalmology Department of UKM between 1 January 1989 and 31 December 1992. The case notes of all such patients were reviewed and data was recorded from those who fulfilled the selection requirements of the study based on the inclusion and exclusion criteria.

The inclusion criteria were as follows:

a) All patients with primary glaucoma above 21 years old who underwent trabeculectomy between 1 January 1989 and 31 December 1992 in UKM.

The exclusion criteria were as follows:

a) All patients who underwent trabeculectomy combined with other operations such as cataract extraction with or without intraocular lens implantation.

b) Trabeculectomies done for juvenile or developmental glaucoma even if the patient is above 21 years old.

c) Any previous surgery on the same eye except for laser procedures.

d) Trabeculectomies done for normal-tension glaucoma.

e) Use of antimetabolites during trabeculectomy.

Since the aim of this study is to find the outcome of trabeculectomy, other surgical procedures done at the same sitting such as cataract surgery with or without intraocular lens implant were excluded. Trabeculectomies done with antimetabolites were also excluded.

Similarly, secondary glaucomas also are additional confounding factors which might alter the outcome of trabeculectomy per se. Patients with developmental glaucomas have poor outcome of trabeculectomy. The inclusion of such patients in this study will affect the true outcome of this study. Such patients should be grouped together for the purpose of other similar studies. Patients with normal-tension glaucomas are excluded from this analysis because the intraocular pressure criteria used to define successful trabeculectomy that is used in this analysis is not applicable to such patients.

All the operations were done according to the standard trabeculectomy techniques by the lecturers in the Department of Ophthalmology in UKM. The only difference between the operations was that some were done with a limbal-based conjunctival flap while the rest were done with fornix-based conjunctival flaps.

The following data were collected:

1) Gender;
2) Race;
3) Type of Glaucoma, namely: a) Primary Open-angle Glaucoma (POAG), b) Primary Acute Angle-closure

Glaucoma (PACG), and c) Chronic Angle-Closure Glaucoma (CACG);

4) Anaesthesia, local or general;
5) Base of Conjunctival Flap;
6) Indications for trabeculectomy;
7) Intraocular pressure:

All intraocular pressures were measured with the Goldmann applanation tonometer. The intraocular pressure at the following periods were noted: a) Intraocular pressure at presentation (Intraocular pressure when the patient was first diagnosed as having glaucoma), b) First Post-Operative Day, c) One week after trabeculectomy, d) One month after trabeculectomy, e) Three months after trabeculectomy, f) Six months after trabeculectomy, g) One year after trabeculectomy, and h) Two years after trabeculectomy. If no follow-up falls on the exact date, the date closest to the determined post-operative date was chosen.

Successful trabeculectomy is defined as intraocular pressure below 20 mm Hg after trabeculectomy without glaucoma medication. Surgical failure is defined as eyes which underwent trabeculectomy whose intraocular pressures were 20 mm Hg and above or eyes which required additional glaucoma medication or repeat trabeculectomies.

Success rates with regards to intraocular pressure control were calculated using the Kaplan-Meier survivorship method[3]. This gives the cumulative success rate and takes into account patient dropout and variable follow-up times. The Kaplan-Meier method predicts the chance of success from the day of surgery to a future point in time, and it eliminates an eye from all further analysis once it has failed. This method gives a more useful indicator of success and is more informative as compared to an overall success rate which means very little.

8) Complications

Intra-operative complications are defined as complications during the operation. Immediate post-operative complications are defined as significant complications between the first to the seventh post-operative day. Complications occurring after the 7th post-operative day will be defined as complications during follow-up.

The presence or absence of blebs and optic cup: disc ratio are not included in the data collection as these observations are deemed to be too subjective with a high rate of inter-observer variation.

All patients who underwent a subsequent operation for the eye under study and those who went for follow-up at other hospitals were excluded from further data collection.

Results

The following results were obtained from the sixty-one eyes which fulfilled the inclusion criteria for this study.

Table I
Distribution of eyes by sex, race and type of glaucoma

Primary Open-Angle Glaucoma (POAG)

	Malay	Chinese	Indian	Total
Males	10	4	4	18
Females	2	2	2	6
Total	12	6	6	24

Primary Acute Angle-Closure Glaucoma (PACG)

	Malay	Chinese	Indian	
Males	0	3	1	4
Females	8	5	1	14
Total	8	8	2	18

Primary Chronic Angle-Closure Glaucoma (CACG)

	Malay	Chinese	Indian	
Males	0	6	1	7
Females	6	2	4	12
Total	6	8	5	19

Forty-three eyes underwent trabeculectomy under local anaesthesia while 18 eyes underwent trabeculectomy

under general anaesthesia. For those eyes that underwent trabeculectomy under local anaesthesia, 16 were eyes with POAG, 11 were eyes with PACG and 16 were eyes with CACG. For those eyes that underwent trabeculectomy under general anaesthesia, 8 were eyes with POAG, 7 were eyes with PACG, while 3 were eyes with CACG.

Forty-three eyes underwent trabeculectomy with limbal-based conjunctival flaps while 18 eyes underwent trabeculectomy with fornix-based conjunctival flaps. For those eyes that underwent trabeculectomy with limbal-based conjunctival flaps, 17 were eyes with POAG, 11 were eyes with PACG, and 15 were eyes with CACG. For those eyes that underwent trabeculectomy with fornix-based conjunctival flaps, 7 were eyes with POAG, 7 were eyes with PACG, and 4 were eyes with CACG.

Failed Medical Treatment was the indication for trabeculectomy in 36 eyes. Thirteen were eyes with POAG, 12 were eyes with PACG and 11 were eyes with CACG. Poor compliance was the indication for trabeculectomy in 22 eyes. Ten were eyes with POAG, 6 were eyes with PACG and 6 were eyes with CACG. Trabeculectomy was done as a primary procedure in 3 eyes; 1 of which was an eye with POAG while the other 2 were eyes with CACG.

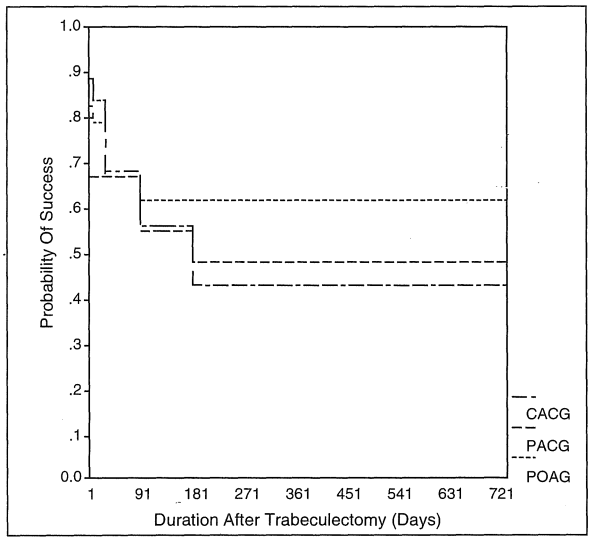

Fig. 1 Graph of success rates of intraocular pressure control as calculated using Kaplan-Meier method

Post-Trabeculectomy Intraocular Pressure:

Complications

Overall, thirty eyes (49.2%) had complications while the number of eyes without any complications was 31 (50.8%).

Intra-operative complications:

All the trabeculectomies were intra-operatively uneventful with no significant intra-operative complications.

Immediate post-operative complications:

Thirty-seven eyes were without any immediate post-operative complications. Twenty-four eyes had complications in the immediate post-operative period.

In eyes with primary open-angle glaucoma (POAG), 12 eyes had immediate complications, while 12 eyes had no immediate complications. In eyes with primary acute angle-closure glaucoma (PACG), 2 eyes had complications in the immediate post-operative period while 16 eyes had no complications during the same period. In eyes with chronic angle-closure glaucoma (CACG), 9 eyes had no immediate post-operative complications while 10 eyes had such complications.

The commonest complication in the immediate post-operative period was shallow anterior chamber (14 eyes, 22.9%). Second commonest was hyphaema (12 eyes, 19.7%). Two eyes (3.3%) had wound leak, two eyes (3.3%) had excessive anterior chamber reaction and one eye (1.6%) had choroidal detachment and 1 eye (1.6%) had conjunctivitis.

Primary open-angle glaucoma:

In eyes with primary open-angle glaucoma, 7 eyes (29.2%) were noted to have hyphaema. Shallow anterior chamber occurred in 5 eyes (20.8%). Choroidal detachment was noted in one of these eyes (4.2%). Conjunctivitis occurred in 1 eye (8.3%). One eye developed excessive anterior chamber reaction (4.2%) in the immediate post-operative period.

Primary acute angle-closure glaucoma:

Of the two eyes which developed complications in the immediate post-operative period; 1 eye was noted to

have hyphaema (5.6%) and another eye developed an excessive anterior chamber reaction (5.6%).

Primary chronic angle-closure glaucoma:

In eyes with chronic angle-closure glaucoma, shallow anterior chamber occurred in 9 eyes (47.4%). Choroidal detachment was noted in 1 of these eyes. Wound leakage occurred in 1 eye. Hyphaema occurred in 4 eyes (21.1%).

Complications during follow-up:

In eyes with primary open-angle glaucoma, 5 eyes had complications during follow-up while 19 eyes had no complications during follow-up. In eyes with primary acute angle-closure glaucoma, 2 eyes had complications during follow-up, while 16 eyes had no complications during follow-up. In eyes with chronic angle-closure glaucoma, 1 eyes had complications during follow-up while 18 eye had no complications during follow-up.

Complications that occurred during follow-up were of 4 types; cataracts (5 eyes, 8.2%), wound leak (4 eyes, 6.6%), choroidal detachment (1 eye, 1.6%) and cystic bleb (1 eye, 1.6%).

Primary open-angle glaucoma:

In eyes with primary open-angle glaucoma, conjunctival wound leak occurred in 3 eyes (12.5%). In one of the eyes, shallow anterior chamber was noted on the 8th post-operative day because of wound breakdown. One eye developed cataract 20 months after trabeculectomy (4.2%). This eye was subsequently excluded from the study when it underwent cataract extraction. One eye developed a cystic bleb (4.2%) 6 months after trabeculectomy.

One of the eyes had shallow anterior chamber, conjunctival wound leak and also choroidal detachment. Another eye had both shallow anterior chamber and excessive anterior chamber reaction. One eye had both hyphaema and also wound leak.

Primary acute angle-closure glaucoma:

In eyes with primary acute angle-closure glaucoma, 2 eyes (11.1%) developed cataracts. They were both subsequently excluded from the study when they underwent cataract extraction, one eye being operated at 14 months and the other eye being operated at 22 months after trabeculectomy.

Primary chronic angle-closure glaucoma:

In eyes with chronic angle-closure glaucoma, 2 eyes developed cataracts (10.5%). One of these eyes underwent cataract extraction 10 days after trabeculectomy and the other eye underwent cataract extraction 5 months after trabeculectomy. Both were then excluded from the study at the time of cataract extraction. One eye developed wound leakage 3 weeks after trabeculectomy.

One eye had multiple complications; this eye developed hyphaema, shallow anterior chamber and choroidal detachment and required anterior chamber reformation. This eye was subsequently excluded from the study when it underwent repeat trabeculectomy combined with cataract extraction 5 months post-trabeculectomy. One eye had 2 complications; hyphaema and also shallow anterior chamber.

Discussion

The aim of trabeculectomy is to stop the progress of glaucomatous optic nerve damage. Parameters that have been used to assess the success of trabeculectomy have been the same as those used to assess glaucoma control, that is: a) intraocular pressure; b) visual field defects; and c) optic disc cupping. The effect of trabeculectomy on visual acuity is also another parameter used to assess trabeculectomy success in terms of the visual function of the patient.

In this study, intraocular pressure control was used as a criterion for assessing successful trabeculectomy. The outcome of trabeculectomy with regards to visual acuity improvement or deterioration and in terms of progression of visual field defects were not assessed because of incomplete documentation. The effect of trabeculectomy on optic disc cupping was also not assessed in this study because no fundus photographs were taken for any of the patients.

One potential source of error in this audit is that the case notes were written by various ophthalmologists and trainees (under supervision) and this could result

in differing observations. However, the clinical observations are based on standard clinical practice and this provides a reasonable uniformity and consistency in the quality of the case notes.

Another drawback in this study is its vulnerability to incomplete and missing data. Though this was a potential problem in this study, it was not a major one and most of the required data were available.

The number of eyes analysed in this study is quite small, that is only sixty-one. If these are sub-divided into the three groups of glaucoma eyes being studied in this analysis, the number of eyes are even smaller. However, this is unavoidable given the time constraints of this study. A 4-year period of study, 1989 to 1992, was regarded as the optimum period for the purposes of this study.

Although the trabeculectomies were done by various lecturers in the Ophthalmology Department of UKM, they were done according to the standard technique as described by Cairns[2]. They varied mainly in the conjunctival flap being limbal-based or fornix-based. Studies have shown no difference in the outcome of trabeculectomies done with either type of conjunctival flap[4,5,6,7].

This study did not look into optic cup:disc ratio as an indicator of glaucoma control. No optic disc photographs were taken for any of the patients. Funduscopic assessment of optic cup:disc ratio is deemed to be too subjective and too variable as compared to intraocular pressure measurements which are more objective in terms of measurement.

With regards to indications for trabeculectomy, this can only be implied in some of the case-notes. In the majority of eyes, the indications for trabeculectomy were stated in the case-notes. There were a few cases where the author had to make an inference on the indications for trabeculectomy based on the number and type of glaucoma medication, duration between diagnosis and trabeculectomy, and the regularity of attendance at the follow-up clinic.

Being a referral centre for the whole country, many patients attending the eye clinic are poor and frequently come from rural areas quite some distance from the Universiti Kebangsaan Malaysia eye clinic. Difficulty in getting transport results in quite a number of these patients missing their follow-up appointments and not getting a regular supply of glaucoma medication. This is one of the factors causing poor compliance with medication.

Intraocular pressure control:

This study defined successful trabeculectomy in terms of intraocular pressure control because intraocular pressure was the most adequately documented parameter during follow-up. Success rates were calculated using the Kaplan-Meier survivorship method[3]. This gives the cumulative success rate and takes into account patient dropout and variable follow-up times. The Kaplan-Meier method predicts the chance of success from the day of surgery to a future point in time, and it eliminates an eye from all further analysis once it has failed. The increasing awareness of this method of analysis is reflected in the increasing use of this method in recent studies on filtration surgery outcome[8,9,10,11].

On reviewing the literature, a wide variation in reported success rates of glaucoma surgery is found. Most studies use intraocular pressure control as a criterion for successful trabeculectomy. It has been found that between 60 to 90 per cent of patients had intraocular pressures of less than 20 mm Hg following trabeculectomy[8,12]. Other studies have found that between 67 to 74 per cent of patients had average intraocular pressures of less than 21 mm Hg after trabeculectomy[14,15,16].

This could be due to a true variation in the results of the procedure, but more commonly it is due to the data being handled differently. Some studies consider success as intraocular pressure less than 20 mm Hg[8,12] whereas other studies chose 21 mm Hg as the borderline between success and failure[14,15]. Some studies include eyes whose intraocular pressures are controlled with additional medication as successful[8], and others regard such eyes as failed trabeculectomies. Some studies report overall success statistics without regard to follow-up time[2], whereas others report on a success rate related to time since surgery[8,15]. Some studies use visual field changes as criteria for success

or failure of trabeculectomy[16,17]. As such, the results of this study cannot be truly compared to other studies.

It is felt that the criterion of successful trabeculectomy with regards to intraocular pressure control and the method of analysis as used in this study aims to be as useful as possible. Inclusion of eyes with controlled intraocular pressure with medication as successful trabeculectomy will increase the success rate of trabeculectomies done in this centre but this will not give a true picture of the outcome of the surgery itself. Ideally, patients who have undergone trabeculectomy should not need any other types of glaucoma medication if the surgery is deemed to be successful.

The success rate for primary open-angle glaucoma was the best of the three glaucoma groups. Based on the results of this study, patients with primary open-angle glaucoma are expected to do well with trabeculectomy in this centre. Results in patients with chronic angle-closure glaucoma were the poorest. This could possibly be attributed to these eyes usually already having significant areas of angle closure due to peripheral anterior synaechiae before trabeculectomy was done. Long-term topical antiglaucomatous therapy may also induce changes in the conjunctiva and sclera that predispose to trabeculectomy failure[18]. Perhaps an earlier trabeculectomy would increase the success rate of trabeculectomy for this group of patients.

Complications:

With regard to the complications of trabeculectomy, it has been reported that between 50 to 77 per cent of patients who underwent trabeculectomy were free from post-operative complications[8,13]. Flat anterior chamber was a common post-operative complication that was reported to occur in between 5 to 22 percent of cases[8,12,13,14,19]. Post-operative hyphaema occurred in 6 to 17 per cent of cases[8,13,14,19]. Choroidal detachment occurred in 4 to 18 per cent of cases[8,13,14]. Cataracts developed in 20 to 35 per cent of cases[13,14,15,19]. Other complications of trabeculectomy that were reported included uveal prolapse (0.5%)[13], malignant glaucoma (0.7%)[13], retinal detachment (0.2%)[13], severe uveitis (0.8%)[13], and endophthalmitis (0.5%)[13].

Thirty-one eyes in this study had no complications (50.8%) while the number of eyes with complications was 30 (49.2%). This number is similar to that in a study by Yamashita[8] in which 54% of eyes had complications while the other 46% were free of complications. Eyes in the primary open-angle glaucoma group had the highest percentage of complications with sixteen eyes (66.7%) having complications. Eight eyes (33.3%) were free from complications. The majority were due to hyphaema and shallow anterior chamber. These complications resolved without sequelae in the majority of cases.

Shallow anterior chamber was the commonest complication with 14 eyes out of 61 (22.9%) having this complication. In the study by Törnqvist[19] on primary open-angle glaucoma patients, 16% of cases had postoperative hypotony with flat anterior chamber. Choroidal detachment occurred in 4 eyes (6.6%) in this study. This is quite comparable to other studies. Mills[13] found a 5.3% incidence of choroidal detachment in his study. D'ermo[14] reported a 4.9% incidence of postoperative choroidal detachment.

There was a total of 12 eyes with hyphaema in this study (19.7%). In this study any hyphaema that was significant enough to be mentioned in the case notes were included. It is difficult to make comparisons with other studies with regards to the incidence of hyphaema as varying criteria are used. In the study by Tornqvist[19], 17% of eyes developed hyphaema. Some studies record all hyphaemas such as this one but other studies only record hyphaemas which they regard as significant in their analysis[12].

Some studies have suggested that there is an association between trabeculectomy and the development of cataracts[13,14,19,20]. The cause is unknown. It has been postulated that cataract formation after trabeculectomy could be due to: intraoperative lenticular trauma, severe post-operative inflammation, persistent hypotony and choroidal detachment or it may be due to topical corticosteroid usage.

Four eyes (6%) in this study were noted to have cataracts which required cataract extraction during follow-up after trabeculectomy. This is comparable to a study by Watson[12] where 5.7% of patients required cataract extraction but is low compared to other studies[13,14,15,19]. One eye was noted to have cataract but

no cataract extraction was done till after the study period.

The low incidence of cataracts could also be explained by the relatively short duration of follow-up in this study. There is also no standard cataract evaluation method. Various methods have been used to assess cataract progression after trabeculectomy such as visual acuity, biomicroscopy, myopic change in refraction, and various instruments such as a lens opacity meter[20].

The most obvious evidence for cataract progression after trabeculectomy is obviously the need for cataract extraction[20]. In a study by Akafo[15], it was found that 23% of eyes with chronic open-angle glaucoma that underwent trabeculectomy eventually developed cataracts significant enough to require extraction at a mean of 6 years following trabeculectomy. In the same study, 15% of eyes with chronic angle-closure glaucoma required cataract extraction at an average 7.5 years after trabeculectomy. In a study by Tornqvist[19], 21% of eyes had decreased vision due to cataracts about one year after trabeculectomy. The follow-up period was less than 5 years.

Various reported complications of trabeculectomy such as: supra-choroidal haemorrhage[12], ciliary body incarceration[12], staphyloma[12], and endophthalmitis[15,19] were not found in this study.

This study can be improved by prolonging the follow-up period after trabeculectomy for example 5 or even 10 years. It would be interesting to see the outcome of those eyes still on follow-up. Another way to improve the findings of this study is to do a prospective study, whereby the parameters to be measured such as intraocular pressure or visual fields can be made more standardised. Stereoscopic optic disc photographs would also be useful as a parameter to be measured.

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