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Intraocular pressure control after trabeculectomy in the patients with primary open angle glaucoma and pseudoexfoliative glaucoma followed up for 3 to 5 years

Kontrola intraokularnog pritiska kod bolesnika sa primarnim glaukomom otvorenog ugla i pseudoeksfolijativnim glaukomom tokom perioda od 3 do 5 godina nakon trabekulektomije

Vesna Marić*†, Vujica Marković*†, Marija Božić*†, Ivan Marjanović*†, Paraskeva Hentova Senćanić†, Djordje Kontić†

Clinical Center of Serbia, *Clinic for Eye Diseases, Belgrade, Serbia; University of Belgrade, †Faculty of Medicine, Belgrade, Serbia

Abstract

Background/Aim. Trabeculectomy is a safe procedure which effectively reduces the intraocular pressure (IOP). IOP is the most frequent indicator of success after glaucoma surgery. The aim of this work was to evaluate the long-term pressure control in primary open-angle glaucoma (POAG) and in pseudoexfoliative glaucoma (XFG) after primary trabeculectomy without the use of mitomycin-C (MMC), 3 to 5 years after trabeculectomy. **Methods.** This study involved a retrospective evaluation of 332 consecutive patients (352 eyes), 174 patients (188 eyes) with POAG (mean age of 64.0 ± 8.6 years) and 158 patients (164 eyes) with XFG (mean age of 70.7 ± 8.9 years) who underwent primary trabeculectomy between January 2007 and December 2009 at the Clinic for Eye Diseases, Clinical Center of Serbia in Belgrade. A successful control of IOP was defined as achieving IOP ≤ 21 mmHg without medication (complete success), or with a single topical medication (qualified success). **Results.** According to the type of glaucoma POAG/XFG preoperative IOP was 28.4 ± 6.3/30.4 ± 8.4 mmHg, respectively (p = 0.311) and last postoperative IOP was 16.9 ± 5.2/18.7 ± 5.9 mmHg, respectively (p = 0.681). According to the Kaplan-Meier survival curve, the complete success in the group with POAG in 1, 3 and 5 years were 85%, 75% and 58% and in the group with XFG were 82%, 70% and 56%, respectively. There was no statistically significant difference in the complete success rates between the patients with POAG and XFG. **Conclusion.** The primary goal of surgery was to achieve a sufficiently low IOP without additional medication, thus preventing progression of glaucomatous damage. In our study, the complete success in the group with POAG was achieved in 75% and 58% of the patientsin the period of 3 and 5 years after surgery, respectively and in the group with XFG complete success was achieved in 70% and 56% of the patients respectively.

Key words:
glaucoma open angle; exfoliation syndrome; trabeculectomy; intraocular pressure; treatment outcome.

Apstrakt

Uvod/Cilj. Trabekulektomija je sigurna procedura efikasnog snižavanja intraokularnog pritiska (IOP). IOP se uzima kao najčešće merilo uspeha nakon operacije glaukoma. Cilj rada je bio da se ispita dugoročan ishod nakon primarne trabekulektomije bez korišćenja antimetabolita uzimajući u obzir IOP kod bolesnika sa primarnim glaukomom otvorenog ugla i pseudoeksfolijativnim glaukomom u periodu od 3–5 godina nakon trabekulektomije. **Metode.** U studiji je retrospektivno praćeno 332 bolesnika (352 očiju), 174 bolesnika (188 očiju) sa primarnim glaukomom otvorenog ugla (prosečne starosti 64,0 ± 8,6 godina) i 158 bolesnika (164 očiju) sa pseudoeksfolijativnim glaukomom (prosečne starosti 70,7 ± 8,9 godina) kojima je izvršena trabekulektomija u periodu od januara 2007. do decembra 2009. godine na Odeljenju za glaukom Klinike za očne bolesti u Beogradu. Uspešna kontrola IOP je definisana postizanjem IOP manjim ili jednakim 21 mmHg, bez medikamentne antiglaukomne terapije (kompletan uspeh), ili sa jednom vrstom lokalne terapije (delimičan uspeh). **Rezultati.** Kod bolesnika sa primarnim glaukomom otvorenog ugla i sa pseudoeksfolijativnim glaukomom preoperativni IOP je bio 28,4 ± 6,3/30,4 ± 8,4 mmHg (p = 0,311), a postoperativni IOP

Correspondence to: Vesna Marić, Clinical Center of Serbia, Clinic for Eye Diseases, Pasterova 2, 11 000 Belgrade, Serbia.
E-mail: vesbabic@sezampro.rs

16,9 ± 5,2/18,7 ± 5,9 mmHg (p = 0,681). Na osnovu Kaplan-Meier-ove krive preživljavanja, kompletan uspeh kod bolesnika sa primarnim glaukomom otvorenog ugla nakon 1, 3 i 5 godina 85%, 75% i 58% s kod bolesnika sa pseudoeksfolijativnim glaukomom bio je 82%, 70% i 56%. Među posmatranim grupama nije bilo statistički značajne razlike. **Zaključak.** Primarni cilj operacije bio je postizanje dovoljno niskog intraokularnog pritiska bez dodatne terapije čime bi se sprečila progresija glaukomnog oštećenja. U našoj studiji kompletan uspeh u grupi bolesnika sa primarnim glaukomom otvorenog ugla postignut je u 75% i 58% bolesnika nakon 3, odnosno pet godina, dok je u grupi bolesnika sa pseudoeksfolijativnim glaukomom kompletan uspeh postignut u 70% i 56% bolesnika.

Ključne reči:
glaukom otvorenog ugla; eksfolijativni sindrom; intraokularni pritisak; trabekulektomija; lečenje, ishod.

Introduction

Glaucoma is the second leading cause of blindness world-wide and the first cause of irreversible blindness [1]. Glaucoma treatments are directed at reducing the intraocular pressure (IOP), either pharmacologically or surgically [2, 3].

Since the first description of trabeculectomy in 1968 by Cairns [4], it has become the most widely used intervention for the treatment of glaucoma and it is still regarded as the gold standard [5, 6].

Trabeculectomy is a surgical procedure which effectively reduces the intraocular pressure (IOP) in most patients in short term. Over time, the effect of trabeculectomy decreases in a large proportion of patients so that over 3 to 5 years many need additional medical or surgical IOP control. Though morphological optic nerve changes along with visual field the alterations are much more relevant for the follow-up of disease progression, IOP is still the most frequent indicator of purely surgical success of glaucoma surgery.

Prior studies described the long-term effects of trabeculectomy on the IOP [7–11]. The definition 'long-term' is used for the follow-up period ≥ 1 year. The long-term successful control of IOP after primary trabeculectomy ranged from 48%–98%, depending on the follow-up period and the criteria used to define successful outcome [12–14].

In the majority of studies, the postoperative complete success in terms of IOP was described as IOP of 21 mmHg or less, without medication [7, 15, 16].

The current study evaluates the long-term pressure control in primary open-angle glaucoma (POAG) and in pseudoexfoliative glaucoma (XFG) after primary trabeculectomy without the use of mitomycin-C (MMC), 3 to 5 years after trabeculectomy.

Methods

This study involved the retrospective evaluation of 332 consecutive patients (352 eyes); 174 patients (188 eyes) with POAG (mean age of 64.0 ± 8.6 years) and 158 patients (164 eyes) with XFG (mean age of 70.7 ± 8.9 years), who underwent primary trabeculectomy between January 2007 and December 2009 at the Clinic for Eye Diseases, Clinical Center of Serbia in Belgrade, and the follow-up was 3 to 5 years after surgery.

The patients were included in this study based on the following criteria: (1) age > 40 years at the time of the surgery; (2) trabeculectomies performed without antimetabolites; (3) no previous eye surgery or laser intervention; (4) patients with the follow-up period ≥ 3 years after trabeculectomy. The criteria for trabeculectomy included: (1) inability to reach target IOP with maximum tolerated medical therapy in the patients (use of 3 or more topical medications); (2) use of oral medicines (carbonic anhydrase inhibitor); (3) cases where structural and functional progression of disease occurred despite a normal range of IOP with maximum tolerated medical therapy in the patients (use of 3 or more topical medications); (4) existence of ocular allergy and (5) bad compliance. Preoperative data included demographic characteristics, type of glaucoma, preoperative medication and its duration and IOP. Preoperatively, all patients underwent a standard ophthalmic examination including visual acuity (Snellen chart), slit-lamp biomicroscopy, gonioscopy, IOP measurement with Goldmann applanation tonometry and fundus examination using indirect ophthalmoscopy with Volk Superfield lens 90D. The diagnostic observation also included a visual field test using the Threshold C 24-2 Swedish Interactive Testing Algorithm (SITA) standard program using the Humphrey visual field analyzer II (Carl Zeiss, Germany) and scanning laser ophthalmoscopy – Heidelberg retinal tomography (HRT II, Heidelberg Engineering, GmbH, Dossenheim, Germany, version 2.02) exam at least once a year. The diagnoses of POAG and XFG were based on the preoperative definitions: POAG – an optic neuropathy with typical matching disc and glaucoma visual field changes in the presence of an IOP ≥ 22 mmHg without medication and with the gonioscopy finding of wide and open anterior chamber angle and XFG – the same clinical characteristics with the presence of pseudoexfoliation [17]. All operations were performed by five surgeons. All five surgeons used the same technique, fornix based. Routine postoperative management included antibiotic drops for 1 week and topical steroids, 4 times daily, for several weeks. The IOP measurements were performed at the first postoperative day, after 7 days, then 1, 3, 6 and 12 months after the intervention as well at the last obtainable follow-up visit which was within 3 to 5 years. At the last follow-up visit, IOP information was recorded, medications used and any additional operations during the follow-up.

Definition

Successful control of IOP was defined as achieving IOP ≤ 21 mmHg without medication (complete success), or with a single topical medication (qualified success). Failure was defined by IOP > 21 mmHg, IOP ≤ 21 mmHg achieved with more than a single topical medication and requirements for further glaucoma surgery.

All patients signed the informed consent to use their data for the analysis. This study was approved by the Ethics Committee of the Clinical Center of Serbia.

Statistical analysis

Standard descriptive statistics were used. The Kaplan-Meier curves were constructed to assess a successful control of IOP after surgery during the follow-up period. The unpaired Student's *t*-test was used for comparison of the continuous variables. The χ^2 or Fisher's exact tests were used to evaluate the significance of the differences between the categorized data. The Cox univariate and multivariate analyses were performed to assess the predictors of surgery success. Individual differences were considered to be statistically significant for $p < 0.05$. The SPSS version 21.0 (SPSS Inc, Chicago, Ill) was used for all statistical calculations.

Results

The mean duration of preoperative glaucoma medication for the POAG group was 36 months, range 4–360 months (median, 25th–75th percentile) and 24 months, range 3–120 months (median, 25th–75th percentile) for the XFG group ($p < 0.001$).

The patients' characteristics according to the type of glaucoma and the number of preoperative medications are listed in Table 1. The mean IOP preoperatively was 28.4 ± 6.3 mmHg (range 16–48 mmHg) in the POAG group and 30.4 ± 8.4 mmHg (range 17–60 mmHg) in the XFG group ($p = 0.311$). No significant differences were found in the number of topical ($p = 0.085$) and oral ($p = 0.221$) preoperative medicines between the studied group.

One week postoperatively, the mean IOP was 14.6 ± 3.7 mmHg in the POAG group and 14.9 ± 4.3 mmHg in the XFG group ($p = 0.857$) with a statistically significant IOP reduction from preoperatively IOP in both groups: POAG ($p = 0.001$) and XFG ($p = 0.001$).

The mean follow-up period in the POAG group was 50 ± 5 months and in the XFG group was 49 ± 6 months ($p = 0.915$). There was no difference at last IOP according to the type of glaucoma: 16.9 ± 5.2 mmHg (POAG) and 18.7 ± 5.9 mmHg (XFG) ($p = 0.681$). However, there was a significant IOP reduction level at last visit in both groups: 11.5 ± 8.9 mmHg in the POAG group ($p < 0.001$) and 11.7 ± 9.3 mmHg ($p < 0.001$) in the XFG group. There were no statistically significant differences between the POAG and XFG group in the number of postoperative topical ($p = 0.604$) and oral ($p = 0.081$) medicines. The patients' characteristics at last visit are listed in Table 2.

Table 1

Patients' characteristics according to type of glaucoma and the number of preoperative medications

Variables	POAG	XFG	*p*
Number of patients, n	174	158	
Age (years), mean ± SD	64.0 ± 8.6	70.7 ± 8.9	0.001
Male/female, n (%)	85/89 (49/51)	82/76 (52/48)	0.715
Number of eyes, n	188	164	
Duration of preoperative glaucoma medication (months), median; 25th–75th percentile	36; 24–84	24; 12–48	0.023
Preoperative IOP (mmHg), mean ± SD	28.4 ± 6.3	30.4 ± 8.4	0.311
Number of preoperative medicines, n (%)			
topical			
0	6 (3.2)	0 (0)	0.085
1	16 (8.5)	5 (3.1)	
2	48 (25.5)	37 (22.6)	
3	113 (60.1)	116 (70.7)	
4	5 (2.7)	6 (3.6)	
oral	40 (21.2)	46 (28)	0.221

IOP – intraocular pressure; POAG – primary open-angle glaucoma; XFG – pseudoexfoliative glaucoma; n (%) – number (percentage) of patients; SD – standard deviation.

Table 2

Patients' characteristics at the last examination

Variables	POAG	XFG	*p*
Numbers of patients	174	158	
Number of eyes	188	164	
Follow-up after trabeculectomy (months), mean ± SD	50 ± 5	49 ± 6	0.915
Last IOP (mmHg), mean ± SD	16.9 ± 5.2	18.7 ± 5.9	0.681
Reduction in IOP from preoperative level (mmHg), mean ± SD	11.5 ± 8.9	11.7 ± 9.3	0.652
Number of postoperative medicines, n (%)			
topical			
0	110 (58.5)	85 (51.8)	0.604
1	26 (13.8)	33 (20.1)	
≥ 2	52 (27.7)	46 (28.1)	
oral	4 (2.1)	8 (4.9)	0.081

POAG – primary open-angle glaucoma; XFG – pseudoexfoliative glaucoma; IOP – intraocular pressure; n (%) – number (percentage) of patients; SD – standard deviation.

According to the Kaplan-Meier survival curve, the complete success in the group with POAG at 1, 3 and 5 years were 85%, 75% and 58% and in the group with XFG were 82%, 70% and 56%, respectively ($p > 0.05$) (Figure 1). In addition, the complete and qualified successes were 89%, 78% and 69% in the POAG group and 85%, 75% and 66% in the XFG group, respectively (Figure 2).

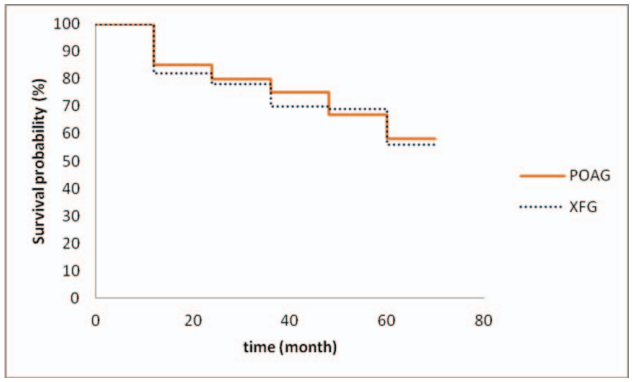

Fig. 1 – Kaplan-Meier curves depicting complete a success in the groups with the primary open-angle glaucoma (POAG) and pseudoexfoliative glaucoma (XFG).

The Cox univariate analysis which included age, gender, duration of glaucoma, number of preoperative medications, preoperative IOP, glaucoma diagnosis (POAG or XFG) and postoperative complications, revealed that the presence of XFG ($p = 0.018$) and higher preoperative IOP ($p = 0.031$) were associated with the decreased complete success. In addition, the Cox multivariate analysis showed that the presence of XFG was associated with the decreased complete success (HR = 2.612; $p = 0.043$). The characteristics between the patients considering a complete success, a qualified success or a failure at the last examination are listed in Table 3 and Table 4.

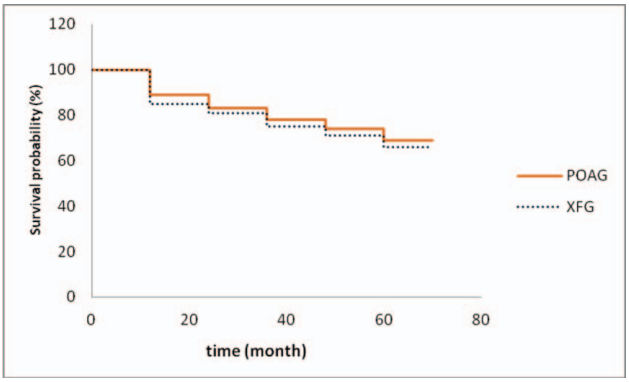

Fig. 2 – Kaplan-Meier curves depicting a complete and qualified success in the groups with the primary open-angle glaucoma (POAG) and pseudoexfoliative glaucoma (XFG).

Table 3
Characteristics of the patients considered a complete success, a qualified success or a failure at the last examination in the group with primary open-angle glaucoma (POAG)

Variable	Complete	Qualified	Failure
Number of patients (%)	102 (59)	16 (9)	56 (32)
Age (years), mean ± SD	64.7 ± 7.7	65.4 ± 5.6	64.3 ± 6.2
Male/female, n (%)	54/48 (53/47)	6/10 (38/62)	27/29 (48/52)
Number of eyes, n (%)	107 (57)	21 (11)	60 (32)
Number of drops preoperatively, mean ± SD	2.5 ± 1.5	2.8 ± 1.3	2.6 ± 0.5
Duration of preoperative glaucoma medication (months), median	48	24	36
Preoperative IOP (mmHg), mean ± SD	27.5 ± 5.2	26.6 ± 5.5	30.6 ± 5.1
IOP after 7 days (mmHg), mean ± SD	13.6 ± 3.5	15.4 ± 4.5	14.8 ± 3.7
Last IOP (mmHg), mean ± SD	15.1 ± 4.1	18.1 ± 2.1	20.2 ± 2.9
Reduction (mmHg), mean ± SD	12.4 ± 8.5	8.5 ± 5.5	10.4 ± 9.7

IOP – intraocular pressure; SD – standard deviation.

Table 4
Characteristics of the patients considered a complete success, a qualified success or a failure at the last examination in the group with pseudoexfoliation glaucoma (XFG)

Variable	Complete	Qualified	Failure
Number of patients, n (%)	77 (49)	15 (9)	66 (42)
Age (years), mean ± SD	72.7 ± 6.8	70.9 ± 9.1	70.3 ± 7.2
Male/female, n (%)	43/34 (56/44)	9/6 (60/40)	30/36 (45/55)
Number of eyes, n (%)	78 (47)	19 (12)	67 (41)
Number of drops preoperatively, (mean ± SD)	2.6 ± 1.2	2.8 ± 0.8	2.9 ± 1.3
Duration of preoperative glaucoma medication (months), median	36	24	32
Preoperative IOP (mmHg), mean ± SD	28.6 ± 5.6	30.9 ± 5.9	32.1 ± 5.2
IOP after 7 days (mmHg), mean ± SD	14.7 ± 4.4	14.9 ± 3.8	15.1 ± 3.4
Last IOP (mmHg), mean ± SD	16.2 ± 3.1	18.3 ± 2.2	21.2 ± 2.4
Reduction (mmHg), mean ± SD	12.4 ± 8.5	12.6 ± 6.1	10.9 ± 7.3

IOP – intraocular pressure; SD – standard deviation.

Postostoperative complications

In our study, the early postoperative complications were common; in the whole study group, the early postoperative complications included hyphema in 16%, hypotony in 21%, a shallow or flat anterior chamber (AC) in 15% and choroidal detachment in 15%, with some of these complications occurring simultaneously. The other postoperative complications were leakage of filtering bleb in 5%, fibrinous reaction in AC in 2%, early postoperative IOP elevation > 30 mmHg where the only significant predictor of failure was increased IOP at the end of the first postoperative month ($p = 0.025$).

Discussion

The main purpose of this study was to determine success rate in the POAG and XFG patients for a long-term IOP control after primary trabeculectomy and the need for further antiglaucomatous treatment, either medical or surgical. The complete success in the POAG group at 1, 3 and 5 years were 85%, 75% and 58% and in the XFG group were 82%, 70% and 56%, respectively.

Glaucoma represents a significant public health concern and if it is left untreated, it can result in progressive optic nerve damage leading to blindness, often without other symptoms [18]. Controlling IOP has been the primary focus of glaucoma treatment. Indications for glaucoma surgical treatment includes visual field deterioration, or progressive optic neuropathy, despite maximum medical therapy, laser therapy, or both [19].

In order to define the success of surgery, it would be ideal to include an assessment of the visual field and the optic disc stability. A major problem is the time required to collect these data and the test frequency to detect progression. To overcome this problem, the IOP control is often used as a surrogate measure of disease stability and the most frequently used measure of success in the studies of glaucoma surgery [20].

In the early days of trabeculectomy, several authors focused on the IOP-reducing effect of the surgery [13, 14, 21]. Watson and Grierson [13] defined the success criteria IOP ≤ 21 mmHg, and found 86% of success with surgery alone and 98% with the use of additional medical therapy and/or surgery in the 10-year study period (424 eyes). Nouri-Mahdavi et al. [14] identified the success rates of 48% and 40% at 3 and 5 years, respectively, with the defined success criteria IOP ≤ 20 mmHg. Cvetkovic et al. [21] analyzed the effect of 100 trepanotrabeculectomy in the primary (79 cases), congenital (16 cases) and the secondary (5 cases) types of glaucoma and the outcome was as follows: in 87% cases, the intraocular pressure was normalized, in 8% the intraocular pressure was normalized with additional medical therapy after surgery, in 3% the pressure could not be controlled even with the additional medicines and in 2% they got hypotony.

No standard definition exists for the success of glaucoma surgery regarding the IOP, because no single target pressure can be achieved as a safe limit for the disease control [22]. We used a limit of 21 mmHg, because it makes this study comparable with most of other studies dealing with the same problem [7, 10, 15, 16].

Khalili et al. [15] defined the same values (IOP < 21 mmHg), although the results were not promising: at 1, 3 and 5 years, the surgery success were 61%, 50% and 38% respectively for all type of glaucoma. The one of possible explanations for such results were the study criteria. They included all types of glaucoma, i.e., neovascular glaucoma which is more refractive on surgery.

Using the same criteria (IOP ≤ 21 mmHg), Ehrnrooth et al. [16] had a less successful outcome; complete success after 1, 2, 3, 4 years were 63%, 54%, 45% and 40%, respectively. However, in this series, the success was not calculated separately according to the type of glaucoma (POAG and XFG).

In recently published study by Molteno et al. [23], the complete success at 1, 2, 5, 10, 15 and 20 years were 95%, 93%, 89%, 82%, 74% and 68%, respectively. Some of the studies with the success rates of IOP after trabeculectomy at the end of the study period that were not mentioned in the text are listed in Table 5.

Follow-up after trabeculectomy

In our study, the mean follow-up was 4 years (range 3–5 years). In a majority of published papers the surveillance time was similar as the one in our study [12, 14]. The advantage of long-term follow-up facilitates better insight of re-introducing the therapy during the monitoring period.

In some papers, the follow-up was 7 to 10 years [29] , and few authors published the follow-up periods exceeding 10 years [8, 9, 11, 30, 31]. In a study by Popovic and Sjöstrand [30], a success rate of IOP control (≤ 21 mmHg) with, or without additional treatment was analyzed in 75 patients. The follow-up after trabeculectomy lasted 6–12 years. The proportion of patients without medications decreased linearly with time from approximately 90% to 60% between 1 and 10 years postoperatively.

Table 5

Success rates of intraocular pressure control after trabeculectomy in the studies at the end of the study period

Study	Number of patients (eyes)	Follow up (years)	Complete (qualified), n (%)
Edmunds et al. [24]	1,240 (1,240)	1	84 (92)
Law et al. [25]	67 (75)	3	47 (68)
Casson et al. [26]	20 (21)	5	67 (90)
Diestelhorst et al. [27]	547 (700)	10	35 (44)
Molteno et al. [28]	193 (289)	15	n/a (85)
Bevin et al. [9]	607 (841)	20	n/a (79)

n/a – not available.

Table 6
Success rates of intraocular pressure (IOP) control after trabeculectomy in the eyes with primary open-angle glaucoma (POAG) and pseudoexfoliative glaucoma (XFG)

Study	N* POAG/XFG	Follow up (years)	Complete success, (%) POAG/XFG
Popovic and Sjostrand [30]	23/21	1	78/81
Edmunds et al. [24]	1,105/64	1	66/70
Serguhn and Spiegel [33]	17/21	2	71/86
Mietz et al. [34]	209/117	5	53/51
Tornqvist and Drolsum [29]	56/107	5	43/64
Mills et al. [12]	220/14	7	73/64

*** N – number of eyes.**

Watson et al. [31] followed up their patients for 22 years, or until the patients died; the probability of successful IOP control (< 20 mmHg) with, or without medication after trabeculectomy, was 96%, 86% and 79% at 1, 10 and 20 years, respectively. Landers et al. [8] found at the end of the 20-year period that approximately 60% patients still had a successful control with no additional therapy and approximately 90% with additional medications.

Using mitomycin-C

MMC is used frequently in the patients undergoing glaucoma filtration surgery to prevent the postoperative conjunctival scarring in order to reduce a possibility of failure of the surgery and to reach a low target pressure [17].

Although it is considered mandatory to use MMC in trabeculectomy, the legal obstacles for MMC off-label use in our hospital group (there is an explicit ban on use off-label MMC for trabeculectomy by our hospital group Ethics Committee which comprises of non-ophthalmologists only). This provided a unique opportunity to analyse a fairly large group of patients for a sufficiently long period enabling us to consider if MMC use is necessary or clearly advantageous in all subsets of patients (primarily regarding age).

Types of glaucoma

Several studies showed a success rate after trabeculectomy only in the patients with POAG; ranging from 65% to 83% without medication and 77% to 98% with the use of additional medical therapy or surgery [13]. On the other hand, similar to our criteria, some studies comparing the results of trabeculectomy in the POAG and XFG patients are listed in Table 6.

In our study, the only factor found to be related with a poor long-term control of IOP in the multivariate analysis was the presence of XFG. Previous studies suggested that an inadequate long-term control of IOP may relate to other various factors, such as the type and/or length of preoperative medication and preoperative laser interventions. In the present study, the patients in the XFG group were significantly older and had a significantly shorter duration of preoperative period than the patients in the POAG group, but neither of these factors proved to be a significant predictor of failure in our series.

In our study, early postoperative complications after trabeculectomy were common, but the only complication associated with a failure was the elevated IOP at the end of the first postoperative month resulting from the insufficient filtration, since we know the subconjunctival scarring is more frequent without the use of antimetabolite. Early postoperative hypotony (21%) was less frequent than the range of 24%–39% reported in various studies about trabeculectomy with MMC using differing definitions [9]. In this series, early postoperative hypotony was not associated with an increased rate of failure. In our study, the leakage of filtering bleb occured in 5% of the whole studied group, while in the literature, the bleb leak was not consistently reported where it was mentioned that the rate varied from nil to 20.4% [32]. It is possible that the obligatory use of antimetabolite is responsible for more frequent complications such as filtering bleb, and therefore the awareness of antimetabolite complications may initiate more vigilance in this regard. Cataract development and its progression is a well-documented complication of trabeculectomy, considered as a late complication of trabeculectomy as also a long-term use of topical steroids. The results of this study, like other long-term studies [16, 26, 30], confirmed that trabeculectomy is a safe operation with a low rate of postoperative complications that offers a good long-term control of IOP in most cases with the rate of failure decreasing with increasing length of following-up. Our study has some limitations. The first one is that the success of trabeculectomy was measured only by the single criteria of IOP. The second limitation is that changes in the visual filed and structural characteristics of the subjects' pre and postoperatively was not mentioned. The analysis of patients regarding the stage of their disease separately was not made, too. Also, it should be noted that the operations were performed by five surgeons; therefore, the difference in their individual success should have been considered, too. An important limitation of the present study is that glaucomatous damage stage, criteria for patient selection and definition success after the surgery varied among the studies and influenced significantly the complete findings. There is difference in the qualified success; in our sudy qualified success of IOP was defined as achieving the IOP $\leq$ 21 mmHg with a single topical medication and in some papers as the IOP $\leq$ 21 mm with one or more topical medications. In addition, it should be taken into account that all trabeculectomies were done without the use of MMC from the reasons already explained above, while

use of MMC is mandatory. Finally, it is important to highlight that in the period between January 2007 and December 2009 more patients had trabeculectomy at the Clinic for Eye Diseases in Belgrade than the number included in our study due to the fact that only those who had follow-up period ≥ 3 year were included.

As it was described above, the primary purpose of the surgery was to stop progress of glaucoma, preferably without an additional therapy. For the elderly patients with the poor general condition the satisfactory IOP control without medication could be the main goal of glaucoma surgery, due to the side-effects of medication, or a weak compliance with the use of topical medicines for glaucoma.

Conclusion

Overall IOP control in the both our patient groups (POAG and XFG) was similar to control reported previously. In our study, the complete success in the group with POAG was achieved in 75% and 58% of the patients in the period 3 and 5 years after surgery, respectively and in the group with XFG complete success was achieved in 70% and 56% of the patients, respectively without a statistically significant difference between the POAG and XFG group. In our study, similar to what was reported previously on the same issue, the IOP reducing effect of trabeculectomy was decreasing gradually.

R E F E R E N C E S

1. *Buys YM, Chipman ML, Zack B, Rootman DS, Slomovic AR, Trope GE*. Prospective randomized comparison of one- versus two-site Phacotrabeculectomy two-year results. Ophthalmology 2008; 115(7): 1130–3.e1.
2. *Shaarawy T, Flammer J, Haefliger IO*. Reducing intraocular pressure: Is surgery better than drugs?. Eye (Lond) 2004; 18(12): 1215–24.
3. *Chen G, Li W, Jiang F, Mao S, Tong Y*. Ex-PRESS Implantation versus Trabeculectomy in Open-Angle Glaucoma: A Meta-Analysis of Randomized Controlled Clinical Trials. PLoS One 2014; 9(1): e86045.
4. *Cairns JE*. Trabeculectomy. Preliminary report of a new method. Am J Ophthalmol 1968; 66(4): 673–9.
5. *Rao K, Ahmed I, Blake DA, Ayyala RS*. New devices in glaucoma surgery. Expert Revi Ophthalmol 2009; 4(5): 491–504.
6. *He M, Wang W, Zhang X, Huang W*. Ologen implant versus Mitomycin C for trabeculectomy: A Systematic Review and Meta-Analysis. PLoS One 2014; 9(1): e85782.
7. *Fernández S, Pardiñas N, Laliena JL, Pablo L, Díaz S, Pérez S,* et al. Long-term tensional results after trabeculectomy. A comparative study among types of glaucoma and previous medical treatment. Arch Soc Esp Oftalmol 2009; 84(7): 345–51. (Spanish)
8. *Landers J, Martin K, Sarkies N, Bourne R, Watson P*. A twenty-year follow-up study of trabeculectomy: Risk factors and outcomes. Ophthalmology 2012; 119(4): 694–702.
9. *Bevin TH, Molteno AC, Herbison P*. Otago Glaucoma Surgery Outcome Study: Long-term results of 841 trabeculectomies. Clin Experiment Ophthalmol 2008; 36(8): 731–7.
10. *Jordan JF, Wecker T, Oterendorp C, Anton A, Reinhard T, Boehringer D,*et al. Trabectome surgery for primary and secondary open angle glaucomas. Graefes Arch Clin Exp Ophthalmol 2013; 251(12): 2753–60.
11. Parc CE, Johnson DH, Oliver JE, Hattenhauer MG, Hodge DO. The long-term outcome of glaucoma filtration surgery. Am J Ophthalmol 2001; 132(1): 27–35.
12. *Mills KB*. Trabeculectomy: A retrospective long-term follow-up of 444 cases. Br J Ophthalmol 1981; 65(11): 790–5.
13. *Watson PG, Grierson I*. The place of trabeculectomy in the treatment of glaucoma. Ophthalmology 1981; 88(3): 175–96.
14. *Nouri-Mahdavi K, Brigatti L, Weitzman M, Caprioli J*. Outcomes of trabeculectomy for primary open-angle glaucoma. Ophthalmology 1995; 102(12): 1760–9.
15. *Khalili MA, Diestelhorst M, Krieglstein GK*. Long-term follow-up of 700 trabeculectomies. Klin Monbl Augenheilkd 2000; 217(1): 1–8; discussion 9. (German)
16. *Ehrnrooth P, Lehto I, Puska P, Laatikainen L*. Long-term outcome of trabeculectomy in terms of intraocular pressure. Acta Ophthalmol Scand 2002; 80(3): 267–71.
17. European Glaucoma Society. Terminology and guidelines for glaucoma. 3rd ed. Italy, Savona: Editrice DOGMA; 2008. p. 155–6.
18. *Quigley HA, Broman AT*. The number of people with glaucoma worldwide in 2010 and 2020. Br J Ophthalmol 2006; 90(3): 262–7.
19. *Razeghinejad MR, Fudemberg SJ, Spaeth GL*. The changing conceptual basis of trabeculectomy: A review of past and current surgical techniques. Surv Ophthalmol 2012; 57(1): 1–25.
20. *Musch DC, Gillespie BW, Niziol LM, Lichter PR, Varma R*. CIGTS Study Group. Intraocular pressure control and long-term visual field loss in Collaborative Initial Glaucoma Treatment Study. Ophthalmology 2011; 118(9): 1766–73.
21. *Cvetkovic D, Blagojevic M, Dodic V*. Experience with trepanotrabeculectomy. ActaOphthalmol (Copenh) 1978; 56(1):150–60.
22. *Palmberg P*. How clinical trial results are changing our thinking about target pressures. Curr Opin Ophthalmol 2002; 13(2): 85–8.
23. *Molteno AC, Bevin TH, Herbison P, Husni MA*. Long-term results of primary trabeculectomies and Molteno implants for primary open-angle glaucoma. Arch Ophthalmol 2011; 129(11): 1444–50.
24. *Edmunds B, Thompson JR, Salmon JF, Wormald RP*. The National Survey of Trabeculectomy. II. Variations in operative technique and outcome. Eye (Lond) 2001; 15(Pt 4): 441–8.
25. *Law SK, Shih K, Tran DH, Coleman AL, Caprioli J*. Long-term outcomes of repeat vs initial trabeculectomy in open-angle glaucoma. Am J Ophthalmol 2009; 148(5): 685–95. e1.
26. *Casson R, Rahman R, Salmon JF*. Long term results and complications of trabeculectomy augmented with low dose mitomycin C in patients at risk for filtration failure. Br J Ophthalmol 2001; 85(6): 686–8.
27. *Diestelhorst M, Khalili MA, Krieglstein GK.*Trabeculectomy: A retrospective follow-up of 700 eyes. Int Ophthalmol 1998–1999; 22(4): 211–20.
28. *Molteno AC, Bosma NJ, Kittelson JM*. Otago glaucoma surgery outcome study: Long-term results of trabeculectomy: 1976 to 1995. Ophthalmology 1999; 106(9): 1742–50.
29. *Tornqvist G, Drolsum LK*. Trabeculectomies: A long-term study. Acta Ophthalmol (Copenh) 1991; 69(4): 450–4.
30. *Popovic V, Sjöstrand J*. Long term outcome following trabeculectomy: I Retrospective analysis of intraocular pressure regulation and cataract formation. Acta Ophthalmol (Copenh) 1991; 69(3): 299–304.

31. *Watson PG, Jakeman C, Ozturk M, Barnett MF, Barnett F, Khaw KT*. The complications of trabeculectomy: A 20-year follow-up. Eye 1990; 4(Pt 3): 425–38.
32. *Edmunds B, Thompson JR, Salmon JF, Wormald RP*. The National Survey of Trabeculectomy. III. Early and late complications. Eye (Lond) 2002; 16(3): 297–303.
33. *Serguhn S, Spiegel D*. Comparison of postoperative recovery after trabeculectomy for pseudoexfoliation glaucoma and chronic primary open angle glaucoma. Klin Monbl Augenheilkd 1999; 215(5): 281–6. (German)
34. *Mietz H, Raschka B, Krieglstein GK*. Risk factors for failures of trabeculectomies performed without antimetabolites. Br J Ophthalmol 1999; 83(7): 814–21.

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