The outcome of filtration surgery in end-stage glaucoma

Rezultati filtracijske kirurgije pri glavkomu v končnem stadiju

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Izvleček

Izhodišča: Ovrednotiti rezultate filtracijske kirurgije pri glavkomu v končnem stadiju.

Metode: V to retrospektivno klinično raziskavo je bilo vključeno 20 oči 20 bolnikov z različnimi oblikami glavkoma v končnem stadiju. Pri vseh očeh je bil narejena goniotrepanacija s skleralnim poklopcem brez medoperativne uporabe antimetabolitov. Izmerjen je bil očesni tlak, ovrednotena je bila najboljša korigirana vidna ostrina, število protiglavkomskih zdravil in rezultati testiranja vidnega polja pred in po kirurškem posegu.

Rezultati: Čas opazovanja po kirurškem posegu je bil pri vseh očeh 24 mesecev. Povprečni očesni tlak je bil pred kirurškim posegom 26,9 mmHg (SD 6,7) in 12,6 mmHg (SD 3,2) ob koncu opazovanja, po kirurškem posegu nižji v celotnem času opazovanja ($p< 0,0001$). Povprečna najboljša korigirana vidna ostrina pred kirurškim posegom je bila 0,44 (SD 0,3), 3 mesece po kirurškem posegu 0,42 (SD 0,3) ($p = 0.253$) in 0,28 (SD 0,2) ob koncu opazovanja ($p = 0,023$). Povprečno število protiglavkomskih zdravil pred kirurškim posegom je bilo 3,0 (SD 0,4), ki se je zmanjšalo na povprečno 0,3 (SD 0,9) ob koncu opazovanja po kirurškem posegu ($p< 0,0001$). Pred kirurškim posegom je bila povprečna vrednost povprečne deviacije pri 11 očeh na avtomatski perimetriji -27,49 dB (SD 2,1) in -27,73 dB (SD 1,6) po kirurškem posegu ($p = 0.289$). Pred kirurškim posegom je bil povprečen otok vidnega polja pri 9 očeh na Goldmannovi perimetriji 19,4° (SD 9,5) in 19,1° (SD 9,9) po kirurškem posegu ($p = 0.347$).

Zaključek: S filtracijsko kirurgijo pri glavkomu v končnem stadiju se je po 24 mesecih opazovanja značilno in stabilno znižal očesni tlak, vid pa je bil ohranjen brez nastanka t. i. pojava »wipe-out«.

Abstract

Background: To evaluate the outcome of filtration surgery in end-stage glaucoma.

Methods: This retrospective study included 20 eyes of 20 patients with different forms of end-stage glaucoma in which goniotrephining with scleral flap without intraoperative antimetabolites was done. Intraocular pressure, best-corrected visual acuity, number of antiglaucoma medications and visual field test results before and after surgery were evaluated.

Results: The follow-up after glaucoma surgery was 24 months in all eyes. The mean preoperative intraocular pressure was 26.9 mmHg (SD 6.7) and 12.6 mmHg (SD 3.2) at the end of follow-up; postoperatively it was lower at all follow-up visits ($p < 0.0001$). The mean preoperative best-corrected visual acuity was 0.44 (SD 0.3), 3 months postoperatively 0.42 (SD 0.3) ($p = 0.253$) and 0.28 (SD 0.2) at the end of follow-up ($p = 0.023$). The mean number of antiglaucoma medications was 3.0 (SD 0.4) preoperatively, decreasing postoperatively to a mean of 0.3 (SD 0.9) at the end of follow-up ($p < 0.0001$). Preoperatively, the mean value of the mean deviation in 11 eyes on automated perimetry was -27.49 dB (SD 2.1), and -27.73 dB (SD 1.6) postoperatively ($p=0.289$). Preoperatively, the mean visual field island in 9 eyes on Goldmann perimetry was 19.4° (SD 9.5), and 19.1° (SD 9.9) postoperatively ($p=0.347$).

Conclusion: Filtration surgery in end-stage glaucoma followed for 24 months resulted in a significant and stable reduction of intraocular pressure and vision was preserved with no occurrences of »wipe-out« phenomenon.

Introduction

There is controversy about the outcome of filtration surgery in end-stage glaucoma. By a number of investigators it has been reported that filtration surgery in end-stage glaucoma may be associated with the risk of immediate unexplained postoperative visual field (VF) loss, which includes fixation with an accompanying change in central visual acuity, termed »wipe-out« phenomenon.[1-4] There are conflicting reports about the frequency of »wipe-out« phenomenon which results in a decreased quality of life for glaucomatous patients. So, some state the rate of severe loss of central vision after filtration surgery as high as 7.7 %, whereas others regard this phenomenon as extremely rare.[1-8]

The purpose of this clinical study was to evaluate the outcome of filtration surgery in end-stage glaucoma during the immediate and mid-term postoperative period.

Patients and methods

In this retrospective clinical study we included all patients from the glaucoma unit of the Department of Ophthalmology of the University Medical Centre Maribor, Maribor, Slovenia, who had different forms of end-stage glaucoma with a cup-disc ratio (C/D) of 1.0 and severe VF defects with partially preserved central function, in whom filtration surgery was performed between January 2002 and December 2007.

All preoperative, operative and postoperative medical data were acquired from accessible medical documentation. The patients were informed of the risks, benefits and alternatives of surgery, and their informed consent was obtained.

The data recorded preoperatively included diagnosis, age, gender, ocular history, duration of glaucoma medical treatment, number of antiglaucoma medications, best-corrected visual acuity (BCVA) (decimal equivalents of Snellens visual acuity), slit lamp examination, Goldmann applanation tonometry, fundus evaluation and perimetry.

End-stage glaucoma was defined on the basis of VF examination. The VF was examined by either automated static perimetry (Swedish Interactive Threshold Algorithm [SITA] standard 30–2 program of the Humphrey Field Analyser) or kinetic perimetry (Goldmann perimetry), depending on the patient's capability to respond at the field examination. All patients had advanced glaucomatous VF loss with mean deviation > -12 dB according to the Hodapp classification on automated perimetry, or an extensive ring-shaped or half-ring-shaped absolute defect in the paracentral VF area with a central island stage IV according to the Aulhorn classification on Goldmann perimetry.[9,10]

Indications for filtration surgery included end-stage glaucoma with a cup-disc ratio (C/D) of 1.0 and severe VF defects with partially preserved central function and insufficient control of intraocular pressure (IOP) including causes such as allergies, low compliance and high number of antiglaucoma medications.

All patients were operated on by an experienced surgeon (T.G.), using local anesthesia after peribulbar injection of mixtures of lidocaine hydrochloride 2 % (Xylocaineâ) and bupivacaine hydrochloride 0.75 % (Marcaine). The surgical technique – superior goniotrephining with a scleral flap without intraoperative antimetabolites – was the same in all eyes.[11] A fornix-based conjunctival flap was created, incising the conjunctiva and Tenon's capsule at the limbus at the 12 o'clock position. A 5 mm x 4 mm half-thickness scleral flap was dissected until the clear cornea was reached. The goniotrephination was carried out with a rotating trephine with a diameter of 1.5 mm and followed by peripheral iridectomy. The scleral flap was closed with two 8.0 Vicryl sutures tied in a way that allowed guarded filtration of aqueous humor. At the end of the operation the conjunctiva was closed using separate 8.0 Vicryl sutures. At the end of the surgical procedure, 4 mg of dexamethasone was applied subconjunctivally to all eyes. The usual postoperative treatment included: cycloplegic eye drops (1 % atropine) once a day for one week; a combination of dexamethasone, neomycin and polymyxin B (Maxitrol) eye

drops five or six times a day for 2 weeks, then four times a day for 2 weeks, then three times a day for 3 weeks, then twice a week for 3 weeks, then once a day for 2 weeks, altogether for the duration of 12 weeks. Intraoperative and postoperative complications and their management were noted.

The data recorded postoperatively included slit lamp examination, Goldmann applanation tonometry, BCVA, number of antiglaucoma medications, fundus evaluation and perimetry. The IOP was measured for one week, at one, 3, 6, 12, 18 and 24 months after surgery. The BCVA and the number of antiglaucoma medications were evaluated 3 months after surgery and at the end of follow-up. The VF test results within 6 months before and 6 months before the last follow-up visit after surgery were used for comparison.

Student's t-test for paired data and the chi-squared test were used for statistical analysis of the results. Significant *P* values were considered to be less than 0.05.

Results

Twenty eyes of 20 patients were included in this retrospective clinical study. There were 12 men (60 %) and 8 women (40 %) and their mean age was 70.7 years (SD 5.7), with a range of 61–83 years. The most frequent diagnosis was pseudoexfoliation glaucoma found in 12 eyes (60 %), 6 eyes (30 %) had primary open-angle glaucoma and 2 eyes (10 %) had chronic angle-closure glaucoma.

Table 1: Baseline characteristics.

Patient	Gender	Age (years)	Eye	Glaucoma Type
1	F	62	OD	PEX
2	F	76	OD	POAG
3	M	61	OD	PEX
4	F	72	OD	PEX
5	M	70	OS	POAG
6	M	76	OD	PEX
7	F	71	OS	PEX
8	F	67	OD	POAG
9	M	83	OS	CAG
10	M	63	OD	POAG
11	F	79	OS	POAG
12	M	76	OD	CAG
13	F	68	OD	PEX
14	M	69	OS	PEX
15	M	76	OS	PEX
16	M	68	OD	PEX
17	M	70	OD	PEX
18	F	67	OS	POAG
19	M	70	OS	PEX
20	M	71	OD	PEX

PEX – Pseudoexfoliation glaucoma
POAG – Primary open-angle glaucoma
CAG – Chronic angle closure glaucoma

The baseline characteristics are listed in Table 1.

All eyes were phakic without demonstration of previous ocular trauma, uveitis or ocular surgery, except for laser trabeculoplasty or laser iridotomy. Before filtration surgery, a selective laser trabeculoplasty was done in one eye (5 %) and a peripheral laser iridotomy was done in one eye (5 %).

The mean duration of glaucoma medical treatment before filtration surgery was 3.0 years (SD 2.8), with a range of 0.5–10 years.

The mean number of antiglaucoma medications before filtration surgery was 3.0 (SD 0.4), with a range of 2–4.

The mean preoperative BCVA was 0.44 (SD 0.3), with a range of 0.01–1.0.

The VF was examined by threshold automated perimetry in 11 eyes (55 %) and by Goldmann perimetry in 9 eyes (45 %). Preoperatively, the mean value of the mean deviation (MD) was -27.49 dB (SD 2.1) on automated perimetry. Preoperatively the mean VF island was 19.4° (SD 9.5) on Goldmann perimetry.

The mean IOP before filtration surgery was 26.9 mmHg (SD 6.7), with a range of 17–43 mmHg.

No intraoperative complications such as anterior chamber hyphema or others were noted.

Postoperatively, transient hypotony with flat anterior chamber and choroidal detachment was noted in 10 eyes (50 %) and resolved in all eyes within 7 days.

The follow-up period after filtration surgery was 24 months in all eyes.

The mean IOP one week after filtration surgery was 7.5 mmHg (SD 2.3), at one month postoperatively 12.7 mmHg (SD 3.7), at 3 months 11.5 mmHg (SD 3.4), at 6 months 11.9 mmHg (SD 3.3), at 12 months 12.5 mmHg (SD 3.0), at 18 months 12.4 mmHg (SD 3.3), and at the end of 24 months of follow-up 12.6 mmHg (SD 3.2). At all follow-up visits after filtration surgery the mean IOP was statistically lower than the mean IOP before surgery ($P < 0.0001$).

The mean BCVA 3 months after filtration surgery was 0.42 (SD 0.3), with a range of 0.01–0.9. The difference between the mean preoperative BCVA and the mean BCVA 3 months after filtration surgery was statistically nonsignificant ($P = 0.253$). At the last postoperative follow-up visit, a cataract with a decrease of BCVA was noted in 4 eyes (20 %). At the last postoperative follow-up visit the mean BCVA was 0.28 (SD 0.2), with a range of 0.01–0.8. The difference between the mean preoperative BCVA and the mean BCVA after filtration surgery at the end of follow-up was statistically significant ($P = 0.023$).

The mean number of antiglaucoma medications 3 months after filtration surgery was 0.25 (SD 0.8), with a range of 0–3. At the last postoperative follow-up visit the mean number of antiglaucoma medications was 0.3 (SD 0.9), with a range of 0–3. The difference between the mean number of antiglaucoma medications before filtration surgery and the mean number of antiglaucoma medications after filtration surgery at the end of follow-up was statistically significant ($P < 0.0001$). In 2 eyes (10 %) antiglaucoma medications had to be added during the follow-up after filtration surgery because of an insufficient reduction of IOP (in one eye two antiglaucoma medications after 3 months and then another one after 6 months; in one eye three antiglaucoma medications 3 months after surgery).

Postoperatively, the mean value of MD was -27.73 dB (SD 1.6) on automated perimetry. The difference between the mean preoperative MD and the mean MD after filtration surgery was statistically nonsignificant ($P = 0.289$). Postoperatively, the mean VF island was 19.1° (SD 9.9) on Goldmann perimetry. The difference between the mean preoperative VF island and the mean VF island after filtration surgery was statistically nonsignificant ($P = 0.347$).

IOP, BCVA, number of antiglaucoma medications and visual field test results before and after filtration surgery in the cohort of 20 patients with end-stage glaucoma are listed in Table 2.

Discussion

Large clinical trials have clearly shown that successful lowering of IOP is associated with a decrease in VF progression.[12-15] Pa-

tients with end-stage glaucoma with a cup--disc ratio (C/D) of 1.0 and severe VF defects with partially preserved central function and insufficient control of IOP are at high risk of further disease progression, which may affect the central vision. A reduction or stabilization of IOP can be achieved either with medication or by surgery. It has been shown that the IOP could be reduced more effectively with filtration surgery than with medication.[14] In patients with end-stage glaucoma surgeons may be hesitant to recommend filtration surgery because of concerns about the possibility of the occurrence of »wipe-out« phenomenon. In the published studies the rate of the occurrence of »wipe--out« phenomenon is controversially evaluated and discussed.[1-8]

Although the exact mechanism of the »wipe-out« phenomenon remains elusive, it has been suggested that it may be associated with the occurrence of sudden, intraoperative ocular hypotony during glaucoma surgery. This may result in optic nerve hemor-

Table 2: Intraocular pressure, best-corrected visual acuity, number of antiglaucoma medications and visual field test results before and after filtration surgery in the cohort of 20 patients with end-stage glaucoma.

Patient	IOP (mmHg) Entry	IOP (mmHg) Exit	BCVA Entry	BCVA Exit	No.GM Entry	No.GM Exit	AP (MD) Entry	AP (MD) Exit	GP (°) Entry	GP (°) Exit
1	23	10	0.16	0.16	3	0	-28.77	-28.99	/	/
2	23	15	0.2	0.2	3	0	/	/	30	30
3	30	17	0.01	0.01	3	0	/	/	20	20
4	30	8	0.1	0.1	3	0	-26.55	-26.88	/	/
5	26	12	0.5	0.4	4	0	-27.50	-27.85	/	/
6	22	10	0.8	0.2	3	0	-29.92	-29.27	/	/
7	34	8	0.7	0.7	3	0	-25.50	-27.24	/	/
8	17	10	0.1	0.05	3	0	/	/	30	30
9	24	14	0.1	0.16	4	0	/	/	20	20
10	26	14	1.0	0.8	3	3	-25.23	-26.00	/	/
11	18	11	1.0	0.1	3	0	/	/	10	7
12	28	20	0.4	0.2	3	3	/	/	20	20
13	27	14	0.7	0.7	3	0	/	/	30	30
14	35	10	0.2	0.2	3	0	/	/	10	10
15	27	12	0.3	0.4	3	0	-30.86	-30.02	/	/
16	28	16	1.0	0.2	3	0	-26.30	-26.50	/	/
17	43	14	0.6	0.2	3	0	-25.84	-26.54	/	/
18	17	12	0.4	0.4	3	0	-30.36	-30.03	/	/
19	24	10	0.01	0.01	2	0	/	/	5	5
20	37	14	0.6	0.5	3	0	-25.57	-25.72	/	/

IOP – Intraocular pressure
BCVA – Best-corrected visual acuity (decimal equivalents of Snellens visual acuity)
No.GM – Number of antiglaucoma medications
AP – Automated perimetry
MD – Mean deviation (dB)
GP – Goldmann perimetry
°–Degrees

rhage and decreased perfusion pressure to an already compromised optic nerve blood supply. It may also include a microembolic episode that could damage the remaining fiers.[7,8]

In their prospective study, which included 26 eyes with end-stage glaucoma, Aggarwal and Hendels evaluated the effect of trabeculectomy without the use of antimetabolites during the immediate postoperative period.[1] The VF was examined by Goldmann perimetry. They reported a postoperative loss of central visual acuity in 4 eyes (15.4 %). In one eye it was the consequence of a macular edema and in one eye of a flat anterior chamber. In 2 eyes (7.7 %) they could not find any explainable reason for the loss of foveal fixation and a decrease in visual acuity. They concluded that there was a considerable risk for the occurrence of »wipe-out« phenomenon after filtration surgery in eyes with end-stage glaucoma.[1]

In their retrospective study, which included 508 eyes with different stages of glaucomatous optic neuropathy, Costa et al. evaluated the effect of trabeculectomy during the immediate postoperative period.[2] The VF was examined by either automated perimetry or Goldmann perimetry. In only 4 eyes (0.95 %) they reported a postoperative loss of foveal fixation and central VF loss that occurred within 3 months after surgery, without any morphological changes on the posterior pole of the eye, which could be a reason for the central vision loss. They concluded that a »wipe-out« phenomenon after filtration surgery in eyes with end-stage glaucoma is a very rare phenomenon, but it can occur.[2]

Thiel et al., in their retrospective study which included 408 eyes with advanced VF loss, evaluated the effect of goniotrephining with a scleral flap without intraoperative antimetabolites.[4] The VF was examined by either Tübinger automated perimetry or Tübinger hand-perimetry. They evaluated the prevalence of the loss of visual acuity due to loss of the central portion of the VF and foveal fixation in the first week after glaucoma filtering surgery. The incidence of such a complication in their study was 0.5 % with regard to all operated patients and 1.4 % with regard to patients with advanced VF defects and preoperative preserved foveal fixation. They concluded that a loss of the central VF and central fixation immediately after filtering surgery is a rare complication.[4]

In their prospective study, which included 21 eyes with end-stage glaucoma, Topouzis et al. evaluated the effect of trabeculectomy with mitomycin-C during the immediate postoperative period.[8] The VF was examined by automated perimetry. They concluded that in their study filtration surgery in end-stage glaucoma followed for 3 months resulted in an effectively reduced IOP and vision was preserved with no occurrences of »wipe-out« phenomenon.[8]

Awai et al., in their retrospective study, which included 49 eyes with end-stage glaucoma, evaluated the effect of trabeculectomy with mitomycin-C and postoperative laser suture lysis during the immediate postoperative period.[5] The VF was examined by Goldmann perimetry. They concluded that in their study filtration surgery in end-stage glaucoma followed for 2 months resulted in an effectively reduced IOP. Also, postoperatively no loss of foveal fixation or loss of central visual acuity was found, and thus no occurrence of »wipe-out« phenomenon was noted.[5]

In their retrospective study, which included 117 eyes with severe VF defects, Law et al. evaluated the effect of trabeculectomy with mitomycin-C during the immediate postoperative period.[6] The VF was examined by automated perimetry. In 7 eyes (6 %) they reported a postoperative central vision loss, which was the consequence of hypotonic maculopathy in 3 eyes, of uncontrolled elevated IOP in 2 eyes, of posterior subcapsular cataract in one eye, and the consequence of inflammatory reaction in one eye. Postoperatively, no loss of central visual acuity or loss of central VF was found that could not be explained by morphological changes on the posterior pole of the eye, and thus no occurrence of »wipe-out« phenomenon was found.[6]

In our retrospective study, which included 20 eyes with end-stage glaucoma, we evaluated the outcome of goniotrephining with scleral flap without intraoperative an-

timetabolites during the immediate and mid-term postoperative period. The VF was examined by either automated perimetry or Goldmann perimetry. During the immediate postoperative period, 3 months after filtering surgery, we found a significant reduction of IOP, a stable VF and stable BCVA. The postoperative transient hypotony with flat anterior chamber and choroidal detachment in half of the operated eyes was the consequence of overfiltration and may be prevented by the use of adjustable or releasable sutures at the time of surgery. During the mid-term postoperative period we found a significant and stable reduction of IOP and a significant decrease in the number of antiglaucoma medications. The statistically significant difference between the mean preoperative BCVA and the mean postoperative BCVA at the end of follow-up, 24 months after filtration surgery can be explained as a consequence of the occurrence of a cataract, which was observed in 4 eyes (20 %). So, in our study after filtration surgery in end-stage glaucoma during the immediate and mid-term postoperative period no occurrence of »wipe-out« phenomenon was observed.

Because of the differences in glaucoma forms, age, gender, previous ocular history, duration of glaucoma medical treatment, type of antiglaucoma medications, amount of glaucomatous optic neuropathy, type of VF examination, grade of VF deterioration, operative technique, number of included eyes, follow-up time, study design, evaluation and statistical analysis of the results of included patients, a comparison of the mentioned studies is very difficult and its possibility limited. The result of our study of a significant reduction of IOP and no occurrence of »wipe-out« phenomenon during the immediate postoperative period after filtration surgery in end-stage glaucoma are consistent with the results of studies performed by Topouzis et al., Awai et al. and Law et al.[8,5,6]

There are limitations of interpreting results from outcome studies. There is no control group in such a study. Surgical outcome studies allow the comparison of individual or group practitioner results with other published historical surgical reports or with selected subpopulations within the same outcome study. Despite the limitations, meaningful information can be derived from outcome studies. The results of our study provided information about the outcome of filtration surgery in end-stage glaucoma during the immediate and mid-term postoperative period that resulted in a significant and stable reduction of IOP and vision was preserved with no occurrences of »wipe-out« phenomenon.

On the basis of the results of our own and other studies we can conclude that a »wipe-out« phenomenon after filtration surgery in end-stage glaucoma represents a very rare complication. Therefore, end-stage glaucoma should not be a contraindication for filtration surgery.

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