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Efficacy and safety of deep sclerectomy in uveitic glaucoma

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Abstract *Purpose* To evaluate the safety and efficacy of deep sclerectomy with implant and mitomycin C in uveitic glaucoma. *Design* Prospective, noncomparative case study. *Patients and methods* Nine patients (13 eyes) with uncontrolled uveitic glaucoma underwent deep sclerectomy with implant from 2002 to 2006. All patients had their uveitis controlled before and after surgery with anti-inflammatory therapy. *Main outcome measures* Control of intraocular pressure. A secondary outcome measure was the number of antiglaucoma medications required to achieve the desired intraocular pressure. Visual acuity and complication associated with the surgery were monitored. *Results* Mean follow-up was 21 months (range 12–54 months). Intraocular pressure (IOP) was reduced from a mean preoperative value of 28.7 mmHg to a mean postoperative value of 13.85 mmHg (Wilcoxon signed rank test $P = 0.005$). At the most recent visit, complete success was obtained in 84.6%, qualified success was obtained in 7.7%, and complete failure in 7.7%. Mean number of antiglaucoma medications was reduced from 3.07 to 0.2 (Wilcoxon signed rank test $P = 0.001$). Neodymium:YAG goniopuncture was performed in two eyes. Postoperative complications included transient hypotony with maculopathy in one eye, shallow choroidal effusions in two eyes, and progression of cataract in four eyes. *Conclusion* Deep sclerectomy with implant in uveitic glaucoma appeared to be effective in controlling the IOP at short-term follow-up with no serious postoperative side-effects.

Keywords Deep sclerectomy · Uveitic glaucoma

Glaucoma is a common and potentially devastating complication of uveitis [1, 2], and remains a challenging management problem despite the availability of many new medical treatments for both conditions. The prevalence of secondary glaucoma in patients with uveitis is reported to be 10–20% [3–6]. This variation in the prevalence of glaucoma can be a reflection of the spectrum of uveitis represented in different studies, age at presentation, and chronicity and severity of uveitis [6, 7]. Intraocular pressure elevation in patients with uveitis can occur as a result of angle closure with or without pupillary block, or with open angle secondary to a combination of biochemical and cellular changes in aqueous composition, direct inflammation of trabecular meshwork, and the effect of corticosteroid on the trabecular meshwork [1, 7, 8]. Herbert et al. [5] found that good control of intraocular pressure in uveitic glaucoma can be achieved using medical management in 70%

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of the eyes and 30% will need a combination of medical and surgical management.

Trabeculectomy with or without antimetabolites has well-documented complications, including hyphema, anterior chamber inflammation, shallow or flat anterior chamber, hypotony, cataract formation, and choroidal detachment [9]. Deep sclerectomy surgery has been suggested as an alternative to trabeculectomy. The nonopening of the anterior chamber and the avoidance of a peripheral iridectomy may lower the incidence of such complications while retaining the efficacy of trabeculectomy [8, 10–20]. The aim of this study is to evaluate the safety and efficacy of deep sclerectomy with implant in uveitic glaucoma.

Patients and methods

An open, prospective noncomparative study of deep sclerectomy with implant was carried out with a consecutive series of patients with uveitic glaucoma managed at King Abdulaziz University Hospital, Riyadh, Saudi Arabia. Those patients with a history of raised intraocular pressure before the clinical onset of uveitis were excluded. All patients had no previous ocular surgery except patient 13 (Table 1) who underwent two failed trabeculectomy surgeries. All patients had open angle on gonioscopic examination. After obtaining approval from the ethical committee of King Saud University, the patients were enrolled consecutively. Informed consent was obtained from all participants.

The indication of deep sclerectomy was uncontrolled glaucoma, which was defined as high intraocular pressure (>21 mmHg) with maximum tolerated medical treatment, progressive glaucomatous visual field loss or progressive optic disc cupping. On the day before surgery, patients underwent best-corrected visual acuity assessment and intraocular pressure was measured using Goldman applanation tonometer mounted on a slit lamp. Gonioscopy examination was

Table 1 Deep sclerectomy with implant in uveitic glaucoma

Eye no.	Age (years)/sex	Etiology	Pre-op. VA	Pre-op. IOP	Pre-op. meds.	Follow-up (months)	Post-op. VA	Post-op. IOP	Post-op. meds.
1	20F	Vogt-Koyanagi Harada disease	20/28.5	27	4	54	20/28.5	18	0
2	20F	Vogt-Koyanagi Harada disease	20/28.5	29	4	54	20/28.5	16	1
3	22F	Vogt-Koyanagi Harada disease	20/22	34	3	15	20/20	13	0
4	22F	Vogt-Koyanagi Harada disease	20/200	39	3	15	20/200	12	0
5	36F	Vogt-Koyanagi Harada disease	20/60	32	3	18	20/80	8	0
6	49M	Idiopathic	20/20	16	3	12	20/20	15	0
7	11F	Juvenile idiopathic arthritis	20/22	32	3	15	20/22	8	0
8	11F	Juvenile idiopathic arthritis	20/22	27	3	12	20/22	12	0
9	40M	Vogt-Koyanagi Harada disease	20/60	10	3	12	20/20	16	0
10	40M	Vogt-Koyanagi Harada disease	20/40	10	3	12	20/20	15	0
11	14M	Idiopathic	20/20	42	2	18	20/20	10	0
12	33F	Vogt-Koyanagi Harada disease	20/22	40	3	21	20/22	16	2
13	16F	Idiopathic	20/20	35	3	12	20/20	16	0

VA, Snellen visual acuity; pre-op., preoperative; post-op., postoperative; meds., medications; IOP, intraocular pressure

done for all patients and number of antiglaucoma medications was recorded.

All patients went through a unified preoperative preparation protocol. They were admitted 3 days before surgery. Immunosuppressive and/or immunomodulatory therapy and maximum tolerated antiglaucoma medications were continued. Prednisolone acetate 1% eye drops every hour was started 7 days before surgery and additional pulses of intravenous methylprednisolone 15 mg/kg per day were given for 3 days preoperatively. All patients had controlled inflammation (0 cells—occasional cells) before surgery.

Surgical technique

All surgeries were performed by the same surgeon (S.A.A.) under general anaesthesia or peribulbar anaesthesia consisting of 3 ml lidocaine hydrochloride 2% (Xylocaine), 3 ml bupivacaine 0.5%, and 1 ml hyaluronidase (Wydase.). After superior rectus muscle 4/0 silk suture was placed, the conjunctiva was prepared with a fornix-based opening at the corneoscleral limbus. The smallest possible cautery for hemostasis was performed using bipolar diathermy and a 5 × 5 mm superficial scleral flap was created and projected for 1.5 mm into clear cornea. The thickness of the flap was almost one-third the scleral thickness. A cellulose sponge soaked in a 0.2-mg/ml mitomycin C (MMC) solution was applied for 2 min under the Tenon capsule. At the end of the application time, the area of application of MMC was irrigated with 20 ml balanced salt solution. Then, the flap was everted over the cornea and a second deeper rectangular scleral flap was created, leaving a very thin layer of scleral tissue over the uvea. This second flap was projected anteriorly to deroof Schlemm's canal and to remove the cornea stroma until the Descemet membrane was observed under high magnification. Wet cellulose sponge was used to push the Descemet membrane down and the floor of Schlemm's canal was stripped using toothed forceps. The deep scleral flap was excised and an implant drainage device, either T-flux (Ioltech, La Rochelle, France) or SKGEL (Corneal Laboratories, Paris, France), was placed radially in the centre of the deep sclerectomy dissection. The T-flux implant was secured with single 10/0 nylon suture to the thin remnant scleral layer, posterior to Schlemm's canal. The superficial scleral flap was then repositioned over the implant and secured with two 10/0 nylon sutures; the knots were buried. The conjunctiva and Tenon's capsule were closed with a 9/0 vicryl suture. Finally, 4 mg dexamethasone and 20 mg gentamicine in a 1 ml syringe was injected in the lower fornix, combined dexamethasone 0.1% and tobramycin ointment was applied, and the eye was patched.

Postoperatively, topical prednisolone acetate 1% was used every hour then in a tapered manner over 12 weeks. Topical ofloxacin four times a day was used for 4 weeks. All patients continued their maintenance dose of immunosuppressive and/or immunomodulatory drugs to control their uveitis. All patients were seen on postoperative day 1, after 1 week and 1, 2, and 3 months, then every 3 months. At each visit, patients underwent best-corrected visual acuity assessment, slit-lamp examination, intraocular pressure measurement using Goldman applanation tonometer, and fundus examination. Extra visits were planned if necessary.

Goniopuncture with a neodymium–yttrium aluminum garnet (Nd–YAG) laser was performed when the target IOP range for each patient was not achieved because of insufficient filtration through the trabeculo-Descemet's membrane.

Surgery was considered a complete success when IOP at last follow-up was ≥ 6 and ≤ 22 mmHg without antiglaucoma medication, and a qualified success when IOP was ≤ 22 mmHg with antiglaucoma medication. Surgery was considered a complete failure when IOP was >22 with antiglaucoma medication or when the eye required further glaucoma surgery to control the IOP.

Statistical analysis

Data were analyzed using the Wilcoxon signed rank test to evaluate the statistical significance of change in IOP and the number of required medications when comparing the value before and after deep sclerectomy. A *P*-value less than 0.05 indicated statistical significance.

Results

The study population was comprised of five females and four males with a mean age of 26 years (range 11–49 years) (Table 1). A total of 13 eyes in 9

patients were included in the data analysis. All 13 eyes completed 12 months follow-up in this study. The mean follow-up time was 21 months (range 12–54 months). The uveitic etiologies of these patients included Vogt-Koyanagi Harada disease (eight eyes), juvenile idiopathic arthritis (two eyes), and idiopathic uveitis (three eyes) (Table 1).

All patients underwent deep sclerectomy with implant and MMC. Two eyes (nos. 9 and 10) required phacoemulsification with posterior chamber intraocular implantation at the time of deep sclerectomy surgery (Table 1). There were no intraoperative complications recorded in this series.

Preoperative visual acuities ranged from 20/20 to 20/200, the mean preoperative IOP was 28.7 mmHg (standard deviation 10.7 mmHg) (Fig. 1), and the mean number of preoperative antiglaucoma medications was 3.07 (range 2–4) (Fig. 2). The postoperative visual acuities ranged from 20/20 to 20/200. At the most recent visit, three eyes (23%) had improvement of vision, whereas six eyes (46%) had no change in their vision. Four eyes (31%) lost one to three lines of vision secondary to lens opacity.

The postoperative IOP was significantly reduced after deep sclerectomy with implant. At 12 months, the mean postoperative IOP was 15.15 mmHg (standard deviation 6.71 mmHg) compared with mean preoperative IOP of 28.7 mmHg ($P = 0.003$, Wilcoxon signed rank test). At the most recent visit, the mean postoperative IOP was 13.85 mmHg (standard deviation 2.8 mmHg) compared with mean preoperative IOP of 28.7 mmHg (standard deviation 10.7 mmHg) ($P = 0.005$, Wilcoxon signed rank test) (Fig. 1). The mean number of antiglaucoma medications significantly reduced from 3.07 (range 2–4) preoperatively to 0.2 (range 0–2) postoperatively

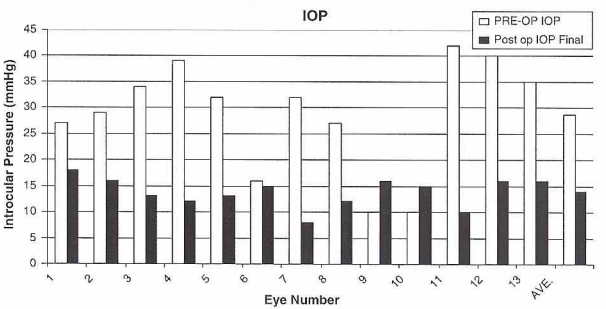

Fig. 1 Summary of preoperative and postoperative intraocular pressure (IOP) of each of the 13 eyes in the study. The average preoperative and postoperative IOP is seen at the right (AVE)

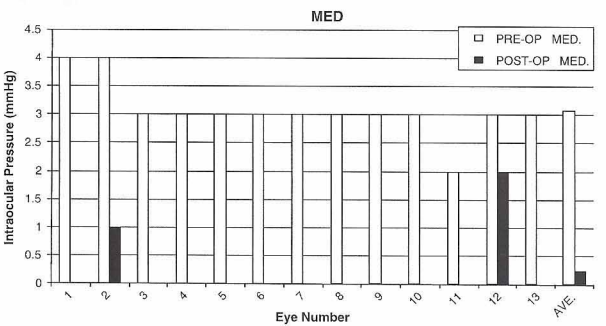

Fig. 2 Summary of the number of preoperative and postoperative antiglaucoma medications. The average is seen at the right (AVE)

($P = 0.001$, Wilcoxon signed rank test) (Fig. 2). At the most recent visit, complete success (IOP $\geq$ 6 and $\leq$22 mmHg without medications) was obtained in 11 eyes (84.6%) and qualified success (IOP $\leq$ 22 mmHg with medication) was obtained in 1 eye (7.7%). One eye (7.6%) (no. 2) had complete failure (Table 1). No patient developed a shallow or flat anterior chamber. None of the eyes had postoperative endophthalmitis or increase in their uveitis. One eye had postoperative hyphema, which resolved spontaneously. Two eyes developed shallow choroidal effusions, which resolved spontaneously without any treatment. One eye had transient hypotony with maculopathy in the early postoperative visit, which resolved spontaneously. Four eyes had progressive lens opacities. Nd–YAG laser goniopuncture was performed in two eyes. Eye 2 at the 9th month visit had IOP of 36 mmHg, which decreased to 20 mmHg after goniopuncture, and for eye 6 at the 15th month visit the IOP was 20 mmHg, which decreased to 12 mmHg after goniopuncture. Eye 2 at the 15th month visit had IOP of 37 mmHg, which was controlled by trabeculectomy surgery.

Discussion

Trabeculectomy is the surgical procedure of choice in uveitic glaucoma when the IOP is uncontrolled despite maximum tolerated medical therapy and in the absence of pupillary block. Although antiproliferative use is controversial, some studies suggest a benefit in terms of long-term IOP control [1, 21]. Without antiproliferatives, trabeculectomy survival (in terms of IOP $\leq$ 21 mmHg) has been reported to be 53% after 5 years (78% with medication) [22]. Another study reported a success rate of 30% after 5 years [23]. A higher success rate (67% at 5 years) was found with trabeculectomy when a single dose of intraoperative 5-fluorouracil was used, although the definition of success in this study included patients controlled on ß-blockers [21]. The success rate of trabeculectomy with postoperative 5-fluorouracil injections was 70% after median follow-up of 35 months [24]. There have been few reports of studies of MMC trabeculectomy in uveitic glaucoma and reports to date have shown no clear advantage over 5-fluorouracil in terms of IOP control [25–27], although in high-risk glaucoma surgery in general, MMC lowers the IOP more than 5-fluorouracil, and may do so for a longer duration [28, 29].

Glaucoma drainage devices are worth considering in uveitic glaucoma with high risk of trabeculectomy failure such as aphakic patients, juvenile idiopathic arthritis, previous trabeculectomy failures, or retinal detachment surgery. The study by Da Mata and Foster [30] reported a success rate of 92% at 1 year with the Ahmed glaucoma drainage device.

Deep sclerectomy has been considered in uveitic glaucoma. Auer et al. [31] reported a mean decrease in IOP by 71.7% in 14 eyes that underwent deep sclerectomy, where six eyes only had collagen implant during surgery. At 12 months, complete success was obtained in 45%, qualified success in 45%, and failure in 9%. The antiglaucoma medication was reduced from a mean of 3.7 $\pm$ 0.5 medications to 1.2 $\pm$ 0.8 medication. Souissi et al. [32] reported a mean decrease of IOP by 52.9% in eight eyes that underwent deep sclerectomy without antimetabolites with mean follow-up of 42.2 months. Complete success was obtained in 50%, relative success was obtained in 37.5%, and failure in 12.5%. Antiglaucoma medications were reduced from a mean of 2.9 to 0.6.

The overall outcome of deep sclerectomy with implant and intraoperative MMC in uveitic glaucoma in this study is very encouraging. The mean reduction of IOP was 48.5%. Complete success was obtained in 84.6%, qualified success was obtained in 7.7%, and complete failure in 7.7%. The antiglaucoma medications were reduced from a mean of 3.07 to 0.2 medications. Our results show a higher success rate than those reported by Auer et al. [31] and Souissi et al. [32]. We believe this is because of the use of the implant and intraoperative MMC in all cases, although there are a number of factors which can influence the success rate, such as the chronic nature of uveitis and disease activity, which makes comparisons between studies very difficult. The use of intraoperative MMC in this study was not associated with any serious side-effects such as sustained hypotony or bleb infection. In our series, 31% of the eyes experienced cataract progression during the postoperative period. There is no definite method to prove that the cataract was not surgically induced, but the fact that all patients had chronic uveitis and had been on topical (with or without systemic) corticosteroids for a long period suggests that surgery might not be the only cause of cataract progression.

In this study we did not observe any exacerbation of uveitis activity after surgery, which should encourage surgeons not to delay surgical intervention in uveitis-related glaucoma. This observation might be explained by the nonpenetrating nature of the surgery and the meticulous use of anti-inflammatory therapy. Our results and those of Auer et al. [31] and Souissi et al. [32] indicate that deep sclerectomy for uveitic glaucoma has a high success rate and is associated with a low rate of intraoperative and postoperative complications. The main limitation of this study is that it was nonrandomized and noncomparative with a small sample and short follow-up.

References

1. Kok H, Barton K (2002) Uveitic glaucoma. Ophthalmol Clin North Am 15:375–387
2. Moorthy RS, Mermoud A, Baerveldt G et al (1997) Glaucoma associated with uveitis. Surv Ophthalmol 41:361–394
3. Merayo-Lloves J, Power WJ, Rodriguez A et al (1999) Secondary glaucoma in patients with uveitis. Ophthalmologica 213:300–304
4. Panek WC, Holland GN, Lee DA et al (1990) Glaucoma in patients with uveitis. Br J Ophthalmol 74:223–227
5. Herbert HM, Viswanathan A, Jackson H et al (2004) Risk factors for elevated intraocular pressure in uveitis. J Glaucoma 13:96–99
6. Neri P, Azuara-Blanco A, Forrester JV (2004) Incidence of glaucoma in patients with uveitis. J Glaucoma 13:461–465
7. Sung VC, Barton K (2004) Management of inflammatory glaucomas. Curr Opin Ophthalmol 15:136–140
8. Auer C, Lehoang P, Herbort C et al (2003) Glaucoma associated with uveitis: review on its appraisal, management, and new surgical prospects. Compr Ophthalmol Update 4:203–210
9. Watson PG, Jakeman C, Ozturk M et al (1990) The complications of trabeculectomy (a 20-year follow-up). Eye 4(Pt 3):425–438
10. Rekonen P, Kannisto T, Puustjarvi T et al (2006) Deep sclerectomy for the treatment of exfoliation and primary open-angle glaucoma. Acta Ophthalmol Scand 84:507–511
11. Drolsum L (2006) Longterm follow-up after deep sclerectomy in patients with pseudoexfoliative glaucoma. Acta Ophthalmol Scand 84:502–506
12. Mielke C, Dawda VK, Anand N (2006) Deep sclerectomy and low dose mitomycin C: a randomised prospective trial in West Africa. Br J Ophthalmol 90:310–313
13. Detry-Morel M, Detry MB Five-year experience with non penetrating deep sclerectomy. Bull Soc Belge Ophtalmol 2006:83–94
14. Goldsmith JA, Ahmed IK, Crall AS (2005) Nonpenetrating glaucoma surgery. Ophthalmol Clin North Am 18:443–460 vii
15. Guedes RA, Guedes VM (2005) Nonpenetrating deep sclerectomy in Brazil: a 3-year retrospective study. J Fr Ophtalmol 28:191–196
16. Anand N, Atherley C (2005) Deep sclerectomy augmented with mitomycin C. Eye 19:442–450
17. Shaarawy T, Mansouri K, Schnyder C et al (2004) Long-term results of deep sclerectomy with collagen implant. J Cataract Refract Surg 30:1225–1231
18. Lachkar Y, Neverauskiene J, Jeanteur-Lunel MN et al (2004) Nonpenetrating deep sclerectomy: a 6-year retrospective study. Eur J Ophthalmol 14:26–36
19. Neudorfer M, Sadetzki S, Anisimova S et al (2004) Nonpenetrating deep sclerectomy with the use of adjunctive mitomycin C. Ophthalmic Surg Lasers Imaging 35:6–12
20. Galassi F, Sodi A, Ucci F et al (2002) Deep sclerectomy in primary open angle glaucoma: comparison among different implants. Acta Ophthalmol Scand Suppl 236:63–64
21. Towler HM, McCluskey P, Shaer B et al (2000) Long-term follow-up of trabeculectomy with intraoperative 5-fluorouracil for uveitis-related glaucoma. Ophthalmology 107:1822–1828
22. Stavrou P, Murray PI (1999) Long-term follow-up of trabeculectomy without antimetabolites in patients with uveitis. Am J Ophthalmol 128:434–439
23. Towler HM, Bates AK, Broadway DC et al (1995) Primary trabeculectomy with 5-fluorouracil for glaucoma secondary to uveitis. Ocul Immunol Inflamm 3:163–170
24. Patitsas CJ, Rockwood EJ, Meisler DM et al (1992) Glaucoma filtering surgery with postoperative 5-fluorouracil in patients with intraocular inflammatory disease. Ophthalmology 99:594–599
25. Prata JA Jr, Neves RA, Minckler DS et al (1994) Trabeculectomy with mitomycin C in glaucoma associated with uveitis. Ophthalmic Surg 25:616–620
26. Wright MM, McGehee RF, Pederson JE (1997) Intraoperative mitomycin-C for glaucoma associated with ocular inflammation. Ophthalmic Surg Lasers 28:370–376
27. Ceballos EM, Beck AD, Lynn MJ (2002) Trabeculectomy with antiproliferative agents in uveitic glaucoma. J Glaucoma 11:189–196
28. Akarsu C, Onol M, Hasanreisoglu B (2003) Postoperative 5-fluorouracil versus intraoperative mitomycin C in high-risk glaucoma filtering surgery: extended follow up. Clin Experiment Ophthalmol 31:199–205
29. Katz GJ, Higginbotham EJ, Lichter PR et al (1995) Mitomycin C versus 5-fluorouracil in high-risk glaucoma filtering surgery. Extended follow-up. Ophthalmology 102:1263–1269
30. Da Mata AP, Foster CS (1999) Ahmed valve and uveitic glaucoma. Int Ophthalmol Clin 39:155–167
31. Auer C, Mermoud A, Herbort CP (2004) Deep sclerectomy for the management of uncontrolled uveitic glaucoma: preliminary data. Klin Monatsbl Augenheilkd 221:339–342
32. Souissi K, El Afrit MA, Trojet S et al (2006) Deep sclerectomy for the management of uveitic glaucoma. J Fr Ophtalmol 29:265–268