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ORIGINAL ARTICLE

Efficacy of Long Scleral Tunnel Technique in Preventing Ahmed Glaucoma Valve Tube Exposure through Conjunctiva

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ABSTRACT

Purpose: To evaluate the efficacy of long scleral tunnel technique used in Ahmed glaucoma valve (AGV) implantation in preventing tube exposure through conjunctiva. *Materials and Methods*: Patients of adult age, who were unresponsive to maximum medical treatment and underwent AGV implantation, were divided into two groups and investigated retrospectively. Group 1 consisted of 40 eyes of 38 patients that underwent surgery by long scleral tunnel technique and Group 2 consisted of 38 eyes of 35 patients that underwent implantation by processed pericardium patch graft method. *Results*: The mean age was 54.8 ± 14.6 years (range 26–68 years) and the mean follow-up duration was 46.7 ± 19.4 months (range 18–76 months) for the patients in Group 1, whereas the mean age was 58.6 ± 16.7 years (range 32–74 years) and mean follow-up period was 43.6 ± 15.7 months (range 20–72 months) for the patients in Group 2 ($p > 0.05$). In the course of follow-up, tube exposure was detected in one (2.5%) eye in Group 1 and in three (7.9%) eyes in Group 2 ($p = 0.042$). *Conclusion*: Long scleral tunnel technique is beneficial in preventing conjunctival tube exposure in AGV implantation surgery.

Keywords: Ahmed glaucoma valve, glaucoma drainage device, pericardium patch graft, scleral tunnel, tube exposure

INTRODUCTION

Medical treatment is the primary therapeutic approach for glaucoma in adults. Trabeculectomy surgery is performed in patients in whom glaucoma cannot be controlled despite maximum medical treatment. In eyes with failed trabeculectomy, repeating the filtration surgery using antifibrotic agents such as Mitomycin C and 5-fluorouracil is sometimes unsatisfactory to control the intraocular pressure (IOP).[1,2] Glaucoma drainage devices, such as an Ahmed glaucoma valve (AGV) (New World Medical, Inc., Rancho Cucamonga, CA, USA), are good alternatives for the treatment of such patients.[3–5]

The Ahmed glaucoma valve is a device with a valve (elastomer) that opens when IOP is higher than 12 mmHg and this system lowers the risk of postoperative hypotony. Glaucoma drainage devices are designed to drain aqueous humor by channeling it from the anterior chamber into the subconjunctival space between the rectus muscles. AGV is made of two parts: a silicone tube and a silicone or polypropylene plate. The tube takes place in the subconjunctival space between the anterior chamber and the plate of the device. Sometimes serious complications such as endophthalmitis may occur due to conjunctival tube exposure.[5–7] In order to avoid such complications, a scleral rotation flap or methods such as tenon advancement and duplication as well as pericardium, fascia lata, lyophilized sclera, dura mater, amniotic membrane, cornea, and cellular dermis grafts are being used.[3–5,8–13] The aim of this study was to evaluate the long scleral tunnel technique for the prevention of conjunctival erosions caused by the AGV tube.

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MATERIALS AND METHODS

The study included 78 eyes of 73 patients. Eyes that underwent AGV implantation by the long scleral tunnel technique at the Dr. Lütfi Kırdar Kartal Training and Research Hospital Ophthalmology Clinic between 2007 and 2010 were considered as Group 1, and the eyes in which a silicon tube was covered by a pericardium patch graft were considered as Group 2, and the patient records were evaluated retrospectively. Approval was obtained from the local ethics committee. Written informed consent was obtained from each patient. The study followed the tenets of the Declaration of Helsinki. The mean age was 54.8 ± 14.6 years (range 26–68 years) in Group 1 and 58.6 ± 16.7 years (range 32–74 years) in Group 2; male/female ratio was 22/16 in Group 1 and 19/16 in Group 2. Age and gender distribution were similar between the two groups (t-test, $p > 0.05$). Diagnoses of study patients in both groups are summarized in Table 1, and no significant difference was found between the groups (t-test, $p > 0.05$). Statistical analyses were done using Microsoft Office Excel 2007.

Surgical Technique

All of the surgeries were performed under local or general anesthesia by a single surgeon. To ensure that the tube was open, it was primed with balanced salt solution under aseptic conditions and the operation was performed after viewing passage of the liquid to the plate of the device. The AGV S2 model was used in all eyes. The plate was implanted at the superior nasal quadrant in 16 eyes, and at the superior temporal quadrant in 62 eyes. A fornix-based conjunctival flap was created at 90–120 degrees and 8–10 mm far from the limbus. With care to the rectus muscles, a posterior dissection was performed and the sclera was exposed for the implantation of the plate. The area was cauterized to control bleeding. Three scleral incisions, 10–12 mm, 6–8 mm, and 1.5–2 mm away from the limbus, respectively, were performed. The incisions, which were 2.5 mm in length and one-half to two-thirds the thickness of the sclera in depth, were made parallel to the limbus. The incisions were bond using a 60-degrees bevel-up 2.0 mm crescent knife. By bonding these three incisions, a scleral tunnel was created (Figures 1 and 2). An episcleral plate was inserted behind the insertion of the rectus muscles and behind the equator. The plate was secured to the sclera with two absorbable 7/0 vicryl sutures. Then, the silicone tube of the device was placed in the scleral tunnel. Using the third scleral incision, parallel to the iris, a partial paracentesis was made with a 20-gauge microvitreoretinal (MVR) knife. In group 2, in the patients who did not undergo long scleral tunnel surgery, a silicon tube was loosely attached to the sclera with two 7/0 vicryl sutures, and the tube was covered with a 5×7 mm pericardium

TABLE 1. Demographic characteristic of the study patients.

Characteristics	Group 1	Group 2
Patients (number of eyes)	38 (40)	35 (38)
Age (years); mean ± SD (range)	54.8 ± 14.6 (26–68)	58.6 ± 16.7 (18–76)
Male/female	22/16	19/16
Phakic/pseudophakic/aphakic	9/16/15	10/14/14
Preoperative diagnosis, *n* (%)		
Postkeratoplasty glaucoma	9 (22.5%)	8 (21.0%)
Neovascular glaucoma	7 (20.0%)	8 (21.0%)
Aphakic glaucoma	8 (22.5%)	7 (18.4%)
Pseudophakic glaucoma	2 (5.0%)	1 (2.7%)
Primer open angle glaucoma	6 (15.0%)	5 (13.2%)
Traumatic glaucoma	3 (22.5%)	3 (7.9%)
Uveitic glaucoma	2 (5.0%)	1 (2.7%)
Juvenile open angle glaucoma	2 (5.0%)	3 (7.9%)
Chemical burn glaucoma	1 (2.5%)	1 (2.7%)

SD = Standard deviation

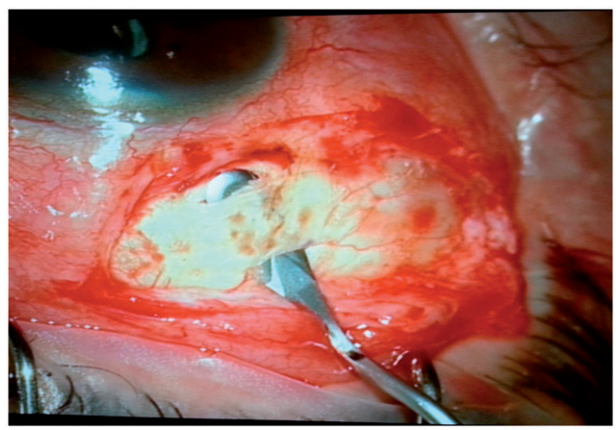

FIGURE 1. Preparation of long scleral tunnel by a crescent knife combining the first and second scleral incisions.

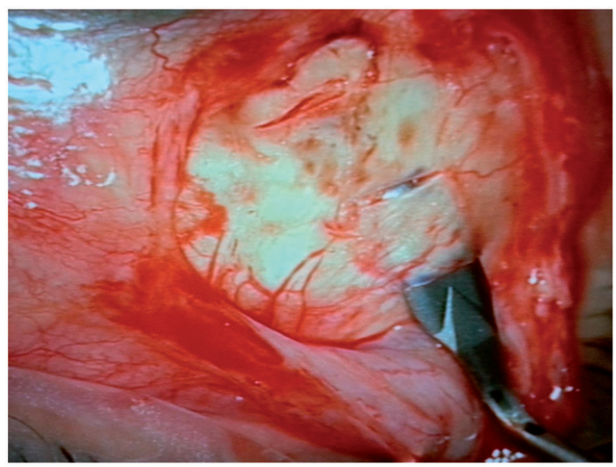

FIGURE 2. Preparation of long scleral tunnel by a crescent knife combining the second and third scleral incisions.

TABLE 2. Summary of results.

Characteristics	Group 1 ($n = 40$)	Group 2 ($n = 38$)
Follow-up (months); mean ± SD (range)	46.7 ± 19.4 (18–76)	43.6 ± 15.7 (20–72)
Anterior vitrectomy, *n* (%)	4 (10.0%)	4 (10.5%)
Tube exposure, *n* (%)	1 (2.5%)*	3 (7.9%)*
Neovascular glaucoma (exposure time, months)	1 (25)	–
Postkeratoplasty glaucoma (exposure time, months)	1	1 (21)
Chemical burn glaucoma (exposure time, months)	–	1 (27)
Juvenile open angle glaucoma (exposure time, months)	–	1 (30)

*$p = 0.042$ (two-sample test of proportions); SD = Standard deviation

patch graft (Totoplast; IOP, Inc., Costa Mesa, CA, USA) by attaching it to the corners with a 9/0 nylon suture, and suture nods were embedded into the sclera. The tube was inserted 1–2 mm into the anterior chamber. When necessary, another paracentesis was made and the anterior chamber was reformed with balanced salt solution or viscoelastic. In case there was vitreous in the pupil and in the anterior chamber, an anterior vitrectomy was performed. The tube was shortened to prevent crystalline lens touch when necessary and an anterior vitrectomy was performed in the aphakic eyes. Perioperative vitrectomy was performed in eight eyes, four eyes from each group. In pseudophakic or aphakic eyes, the tube was inserted into the anterior chamber under or over the iris, considering the presence or absence of peripheral anterior synechia. The scleral incision close to the limbus was closed with an 8/0 polyglactin suture to avoid leakage. Tenon and conjunctiva were sutured separately with 8/0 polyglactin. In order to reform the anterior chamber, a balanced salt solution was injected through a cannula inserted into the paracentesis, and then the conjunctiva was checked for leakage. Subconjunctival injections of gentamicin and dexamethasone were given before the eye was patched. Patients received tobramycine 0.3% and dexamethasone 0.1% eye drops five times daily. After four weeks, tobramycine was stopped, and dexamethasone was continued three times daily for two weeks. Antiglaucomatous medications were stopped after the operation and administered according to IOP measurements when necessary.

RESULTS

The mean follow-up period was 46.7 ± 19.4 months (range 18–76 months) for the patients in Group 1 and 43.6 ± 15.7 months (range 20–72 months) for the patients in Group 2. At the end of follow-up, AGV tube exposure through conjunctival erosion was seen in 1 of 40 eyes (2.5%) in Group 1 and in 3 of 38 eyes (7.9%) in Group 2. This difference was statistically significant ($p = 0.042$, two-sample test of proportions). Tube exposure occurred at 25 months of surgery in one eye of a patient in Group 1 who had AGV implantation because of neovascular glaucoma in both eyes; the AGV was removed. Tube exposure was observed in an eye with glaucoma following penetrating keratoplasty, in an eye with glaucoma following chemical burn, and in one eye with juvenile glaucoma on the twenty-first, twenty-seventh, and thirtieth months, respectively, in group 2. The Ahmed glaucoma valve was removed from the eye with glaucoma following chemical burn since visual loss was no light perception and as the patient had no pain, whereas the other two eyes were repaired with autologous fascia lata graft and by amniotic membrane transplantation obtained from the eye bank. The results are summarized in Table 2.

DISCUSSION

Glaucoma drainage devices, such as AGV, are the options for treatment in controlling intraocular pressure in eyes with previously failed trabeculectomy surgery or in eyes with insufficient conjunctiva for filtration that cannot be controlled by medical therapy. Ahmed glaucoma valve implantation has specific and manageable perioperative and early postoperative complications. However, tube exposure seen in the late postoperative period is one of the most important complications that may cause endophthalmitis, a sight-threatening condition, unless treated. In order to avoid these serious complications, pericardium, fascia lata, lyophilized sclera, dura mater, amniotic membrane, cornea, and cellular dermis grafts are being used as well as a rotational scleral flap or methods such as tenon advancement and duplication.[3–5,8–14] Even though these techniques substantially reduce these complications, they cannot completely eliminate them, Stewart et al.[4] performed a meta-analysis of 38 studies and reported the incidence of tube exposure to be 2% in 3255 eyes of 3150 patients within a mean follow-up period of 26 months. They reported that there was no difference between Ahmed, Baerveldt, and Molteno implants in terms of tube exposure incidence but that tube exposure might occur in any time within the first

five years. Ollila et al.[14] reported no tube exposure in any of 92 eyes in which they performed Molteno implantation by long scleral tunnel technique, in a mean follow-up period of 22 months, whereas they observed tube exposure in 15 (4.5%) of 332 eyes that underwent classical surgery. The technique defined in the present study is a modification of the technique used by Ollila et al.,[14] because we prepared two tunnels without preparing a 4×6 mm limbus-based scleral flap and accessed the anterior chamber angle through the mouth of the tunnel close to the limbus, using a 20G MVR knife, and performed AGV implantation. Tube exposure was detected in 1 (2.5%) out of 40 eyes after a mean follow-up period of 46 months. This patient in Group 1 had neovascular glaucoma in both eyes and underwent AGV implantation in both eyes. Tube exposure occurred in one eye on the postoperative twenty-fifth month and, as there was no visual expectation and pain in that eye with total optic atrophy, the tube was removed. Three (7.9%) eyes in Group 2 had undergone trabeculectomy three times (one with mitomycine C) and tube exposure was observed on postoperative 21, 27, and 30 months. It was determined that AGV implantation performed with the long scleral tunnel technique is more effective in preventing tube exposure ($p = 0.042$). Since the sclera was thin and the conjunctiva was partially avascular, thin, and fragile in the eyes that developed tube exposure, we thought that an autologous fascia lata graft would be beneficial and covered them with amniotic membrane transplant obtained from the eye bank; however, AGV explantation was performed in an eye with no light perception and no improvement.

Lankaranian et al.[8] implanted glaucoma drainage devices and covered the tube using a single-thickness processed pericardium patch graft in 31 eyes and by a double-thickness processed pericardium patch graft in 59 eyes. They observed tube exposure in five (16%) eyes that underwent single-thickness processed pericardium patch graft within a mean follow-up period of nine months, but in none of the eyes that underwent a double-thickness processed pericardium patch graft within a mean follow-up period of eight months. A short follow-up period might be considered as a limitation for the above-mentioned study, as the incidence of exposure may be expected to increase with time.[4] Souza et al.[15] used a processed pericardium patch graft in covering the AGV tube and reported the incidence of tube exposure to be 6% within a mean follow-up period of five years in 78 eyes of 64 patients.

Byun et al.[13] explored the risk factors for tube exposure and found the number of previous surgical procedures to be a risk factor, whereas Souza et al.[15] did not. A tunnel with adequate thickness cannot be created in the eyes with thin sclera such as scleromalacia, buphtalmos, and high myopia and tube coverage would be more appropriate in such eyes. Group 2 eyes that developed tube exposure had previously undergone a trabeculectomy three times, one of which was performed using mitomycine C. Both antimetabolite use and the traumas and surgical interventions that have an impact on the conjunctiva over the tube might have decreased the resistance of the sclera and the conjunctiva. Recently, various surgical approaches and materials as presented herein are under development in order to prevent tube exposure. Multicenter studies with longer follow-up periods are needed. Such efforts would help us to obtain more successful outcomes in time.

DECLARATION OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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