

Outcomes of Ahmed valve surgery for refractory glaucoma in Dhahran, Saudi Arabia

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Abstract

• **AIM:** To evaluate the outcomes of Ahmed glaucoma valve (AGV) implantation surgery for refractory glaucoma.

• **METHODS:** This one-armed historical cohort study was conducted in 2011. Refractory glaucoma was defined as eyes with an intraocular pressure (IOP) greater than 21 mm Hg with maximally tolerated glaucoma medications, failed surgeries, or both. For all eyes with refractory glaucoma that underwent AGV implantation, data were collected on IOP, the best corrected visual acuity (BCVA) and glaucoma medications preoperatively and 4, 6, 12, 24 and 56wk postoperatively. Logarithm values of IOP were calculated and compared.

• **RESULTS:** The study group was comprised of 30 patients (30 eyes, 16 males and 14 females) with refractory glaucoma. Mean preoperative IOP was 39.3 ± 13.8 mm Hg. Postoperative mean IOP was 15.7 ± 7.1 mm Hg, 19.6 ± 12.8 mm Hg and 13.9 ± 14.2 mm Hg at 12, 24 and 56wk respectively. BCVA was $\geq 6/60$ in 11 eyes preoperatively, and five eyes had BCVA $\geq 6/60$ at 56wk postoperatively. Preoperatively, more than four medications were used to treat glaucoma in 21 eyes. At 12wk postoperatively, no medications were required to control IOP in 20 eyes. At 56wk postoperatively, at least one medication was required to control IOP in 10 eyes. Over the entire follow up period, four eyes were treated with yttrium aluminium garnet (YAG) laser and 14 eyes required a second surgery. The AGV was removed in four eyes.

• **CONCLUSION:** AGV implantation reduced IOP and the number of medications required to control refractory glaucoma. However, there was a higher risk of decreased vision. Long-term follow up and prompt intervention are recommended.

• **KEYWORDS:** refractory glaucoma; blindness; Ahmed glaucoma valve surgery

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INTRODUCTION

Refractory glaucoma is defined as uncontrolled intraocular pressure with evidence of optic nerve and/or visual field deterioration despite maximally tolerated anti-glaucoma medications (topical and/or systemic), previously failed non-seton surgical treatment, or a combination of surgery and medicines or a high risk of failure of trabeculectomy^[1].

These cases that do not respond to conventional glaucoma treatment, maybe treated with of Ahmed glaucoma valve (AGV) implants literature^[2-4]. Ishida and Netland^[2] noted that African American race had higher risk of failure of AGV. It was noted to be less effective in refractory glaucoma with neovascular aetiology. Previous glaucoma surgery was a risk factor for failed AGV. The outcomes of AGV implantation (AGVI) in treating various forms of refractory glaucoma are variable.

To our knowledge, few studies have been performed on the adult Arab population with refractory glaucoma^[5-7]. Al-Shahwan^[5] reported single case of tube erosion following AGV. Eid *et al*^[6] suggested positive role of intravitreal bevacizumab in improving success of AGV. Shah *et al*^[7] reported 12% absolute and 78% relative success rates of intraocular pressure (IOP) control following AGV surgery in Oman.

We present the short term and long-term outcomes following AGVI at the Dhahran Eye Specialist Hospital, Eastern province of Saudi Arabia. To the best of our knowledge, this is the first study on refractory glaucoma in an Eastern province of Saudi Arabia.

SUBJECTS AND METHODS

This was a one armed historical cohort study. The Institutional Ethical Committee approved this study. Informed consent was obtained from each patient prior to surgery. Patients were enrolled if they had undergone AGVI

for refractory glaucoma between 2005 and 2010 at the Glaucoma unit of the Dhahran Eye Specialist Hospital.

Two surgeons performed all AGV surgeries in patients with increased IOP that was unresponsive to maximum medical therapy (4 medications), laser treatment or previous glaucoma surgery.

Demographic information included age, sex and eye operated. IOP was measured with Goldmann applanation tonometry (Topcon Corp., Tokyo, Japan). Uncorrected and best-corrected distance visual acuity of each eye was measured (UCVA and BCVA respectively) with a Snellen chart at 6 m from the patient. If the vision was less than 6/60, the patient was retested at progressively shorter distances of 5, 4, 3, 2 and 1 m from the chart. If required, hand motion and light perception with and without projection were tested. Eyes were grouped based on presenting visual acuity; moderate visual impairment (MVI) (6/18 to 6/60); severe visual impairment (SVI) (<6/60 to 3/60) and; blind (<3/60)^[8]. Data were collected on previous laser and surgical treatment for glaucoma and the type of glaucoma. Slit-lamp bio-microscopy of the anterior segment was performed to assess the lens status and the presence of other ocular co-morbidities. The posterior segment was evaluated and the optic nerve status was noted in all eyes. Data were collected on all glaucoma medications (topical and systemic) from the patient charts, medical reports. All patients underwent implantation of the AGV, model FP7 (New World Medical, Rancho Cucamonga, CA, USA). The operative and postoperative data were collected.

Surgery was performed using sub-Tenon's anaesthesia or general anaesthesia. The AGV was implanted in the supro-temporal quadrant in all cases (Figure 1). The plate of the valve was secured to the sclera with prolene 9-0 interrupted sutures. The tube was trimmed with the bevel facing up and was placed in the anterior chamber through a 23-gauge needle track, 2 mm from the limbus (Figure 1). Care was taken to ensure that the tube bevel faced away from the iris. The conjunctiva was closed with 8-0 vicryl sutures and pericardial patch was not used.

Follow up data was recorded at 4, 6, 12, 24 and 56wk postoperatively. The glaucoma subspecialist noted the postoperative visual acuity, IOP, postoperative glaucoma medications (topical and systemic), complications, new medications or surgery performed to manage complications.

Criteria for success were defined as follows. Surgical success was defined in different methods: 1) an IOP decrease greater than 5 mm Hg and less than 21 mm Hg; 2) reduction in number of medications used to control IOP and; 3) improvement/stabilization of vision^[9]. Hypotony was defined as IOP \leq 5 mm Hg on two consecutive visits.

The data were analysed with Statistical Package for Social

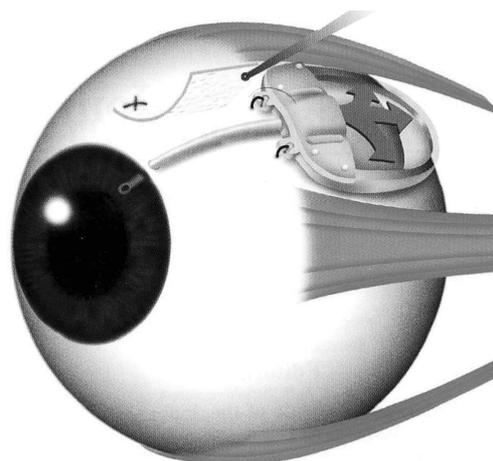


Figure 1 Schematic diagram of AGV location in eye.

Studies (SPSS version 12) software (IBM Corp., Chicago, Ill., USA). Univariate analysis was performed with a parametric method and frequencies, percentage proportions of qualitative variables were calculated. For quantitative variables, we plotted histogram and determined the distribution. Since the distribution of IOP was skewed, the log values of IOP were calculated which were evenly distributed, and the mean and 95% confidence intervals (CI) of the log IOP values were calculated.

RESULTS

The study sample was comprised of 30 eyes with refractory glaucoma (16 males and 14 females). The mean age of participants was 40.5 \pm 27.4y. In eight eyes, refractory glaucoma was secondary to congenital glaucoma. Primary angle-closure glaucoma (PACG) and primary open angle glaucoma (POAG) were diagnosed in five and eight eyes respectively. In seven eyes, refractory glaucoma was secondary to neovascular glaucoma. One eye had uveitic glaucoma and one eye had post-traumatic glaucoma.

Ten eyes (33%) had previously undergone trabeculectomy. Figure 2 presents the decrease in IOP at different follow-up examinations following AGVI. Eyes were divided into two groups based on IOP at follow up visits: normal pressure was defined as IOP < 21 mm Hg and high pressure defined as IOP \geq 21 mm Hg. The comparison of IOP status based on the type of glaucoma is presented in Table 1. The overall success rate (reducing IOP below 21 mm Hg) at 24 and 56wk was 50% and 43%. Eyes with neovascular glaucoma had poorly controlled IOP at 56wk compared to IOP at 24wk postoperatively.

Figure 3 presents the number of medications used to control refractory glaucoma before and after surgery. Postoperatively, there was decrease in the number of drops and medications to control IOP. Postoperatively, 68% and 50% of eyes did not require topical medication for controlling IOP at 24 and 56wk respectively.

Table 1 Intraocular pressure before and after AGVI based on the type of glaucoma

Type of glaucoma	Preop. (n=30 eyes)		24wk postop. (n=22 eyes)		56wk postop. (n=22 eyes)	
	<21 mm Hg	≥21 mm Hg	<21 mm Hg	≥21 mm Hg	<21 mm Hg	≥21 mm Hg
Congenital glaucoma	1	7	4	1	2	1
Primary open angle glaucoma	0	5	1	2	5	0
Primary angle-closure glaucoma	0	8	5	2	3	2
Neovascular glaucoma	0	7	4	2	2	4
Traumatic glaucoma	0	1	0	0	0	0
Uveitic glaucoma	0	1	1	0	1	0

Table 2 Comparison of visual acuity before and after AGVI for refractory glaucoma

Snellen acuity	Before surgery		After surgery					
	n (eyes)	%	12wk		24wk		56wk	
			n (eyes)	%	n (eyes)	%	n (eyes)	%
6/6 to 6/12	1	3.3	2	6.7	1	3.3	0	0.0
6/18 to 6/60	10	33.3	3	10.0	4	13.3	5	16.7
<6/60 to ≥3/60	10	33.3	11	36.7	5	16.7	7	23.3
<3/60	6	20.0	9	30.0	11	36.7	11	36.7
Could not be assessed	3	10.0	3	10.0	3	10.0	3	10.0
Lost to follow up	0	0.0	2	6.7	6	13.0	4	13.3

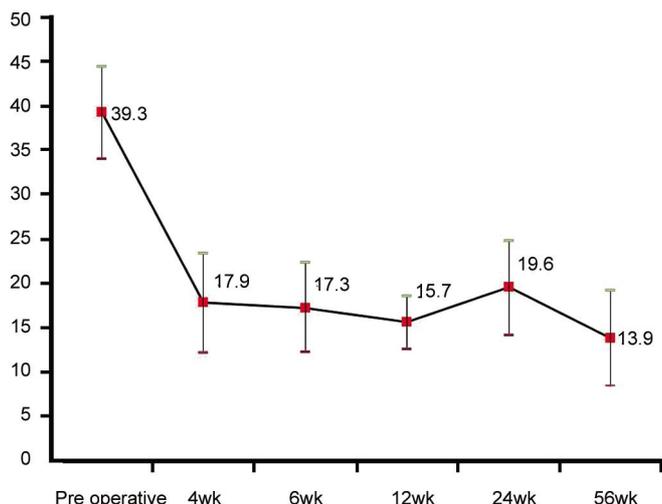


Figure 2 IOP before and after AGVI for refractory glaucoma.

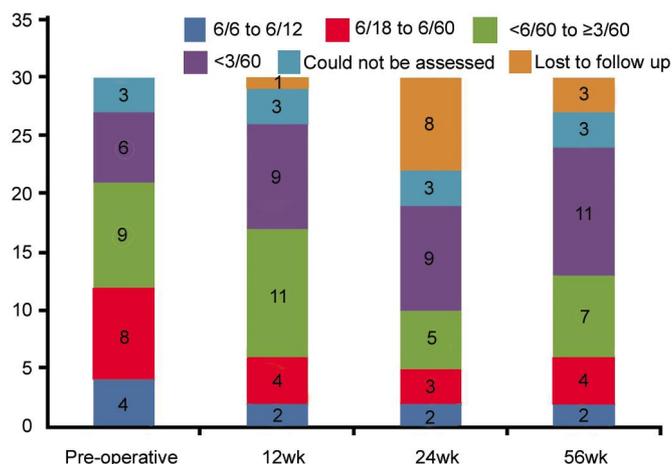


Figure 4 Best corrected visual acuity of eyes before and after AGVI for refractory glaucoma.

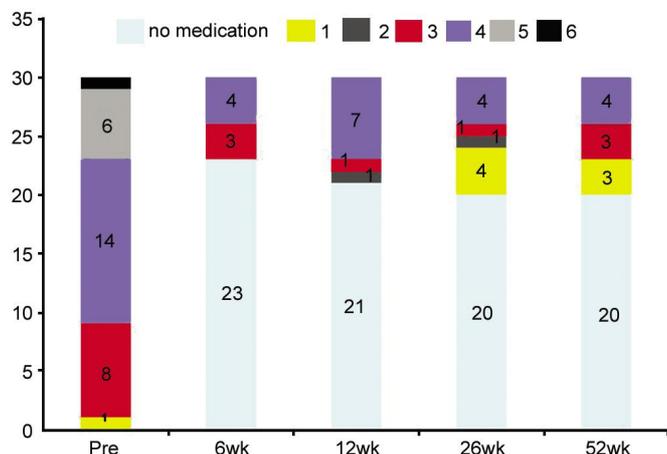


Figure 3 Number of medications to control IOP before and after AGVI for refractive glaucoma.

Vision could not be assessed in three eyes at baseline. MVI was noted in 8 (27%) eyes, SVI was noted in 9 (30%) eyes and 6 (20%) eyes were classified as blind.

Table 2 and Figure 4 compare the BCVA of eyes managed for refractory glaucoma preoperatively, 12, 24 and 56wk postoperatively. A number of patients were lost to follow up. The proportion of blind eyes remained the same during the different follow up visits. However, only light perception was in 20% of eyes at 24wk and 15% of eyes at 56wk.

Among 10 eyes with history of previous glaucoma surgery, AGVI achieved a success rate of 50% while in the rest 20 eyes without a history of glaucoma surgery, the success rate of 75% [RR=1.5 (95%CI 0.6-14.9)]. The difference however, was not statistically significant ($P=0.1$).

As part of continuing post-operative care, 14 eyes underwent operation; three needed needling for flat bleb/encysted bleb and three required re-formation of the anterior chamber. Four AGV's were removed due to complications. Five eyes underwent YAG laser iridotomy.

DISCUSSION

The success rate in reducing IOP below 21 mm Hg at 24 and 56wk following AGVI surgery in our study was 68% . Seventy percent of patients did not require topical medication for controlling IOP at 56wk following AGV surgery. To our knowledge, previous studies have documented the success of the Ahmed valve in Saudi children but outcomes of refractory glaucoma managed with the Ahmed valve in adults remain unreported [10]. Previously, trachoma was endemic in the eastern province of Saudi Arabia [11]. Many elderly Saudis still suffer from the sequelae of blinding trachoma. Additionally, they have conjunctival scarring and dry eye syndrome following trachoma, which makes them likely to respond differently to the prosthesis placed below the conjunctiva to treat refractory glaucoma. Our study provides crucial information that could improve the clinical approach for refractory glaucoma in both Saudi Arabia and other Arab countries where trachoma is endemic.

The success rate for reducing IOP was 68%, one year after AGVI for refractory glaucoma. This is lower than that reported in a review of outcomes of different devices used for treating refractory glaucoma [12]. Das *et al* [13] reported a success rate of 86% at 12mo postoperatively and Shah *et al*[7] had reported a 70% success rate in reducing IOP below 22 mm Hg. Das *et al* [13] considered, IOP greater than 22 mm Hg as high, instead of 21 mm Hg, which could explain the difference in the success rate from our study. Wu *et al*[14] reported that 59% of eyes with refractory glaucoma had ocular hypertension 6mo after AGVI. However, we did not note a transient rise in IOP followed by a sustained decline in IOP after AGVI as reported by Wu *et al* [14]. If mean IOP at follow-up is compared to preoperative levels rather than comparing it statistically eye by eye, a false sense of success could arise as many eyes with high IOP postoperatively would be included with those with hypotony or normal IOP[15,16]. It would be beneficial for patients with refractory glaucoma if the number or frequency of medications to control IOP were reduced. This parameter of success in our study indicated that 70% were not using medications at one year postoperatively while another 20% had a reduction in the number of medications to treat glaucoma. This observation concurs with Souza *et al*[14] and Wishart *et al*[17] who reported a significant decline in the number of medications following AGVI.

Improved vision after AGV surgery may not be accurate success criteria due to existing comorbidities that may reduce

vision during follow-up[18]. If quantitative visual acuity is used as a benchmark and change of one line of Snellen acuity is defined as stable vision, Das *et al* [13] reported a 98.4% success rate. In our series, visual acuity in eyes with refractive glaucoma was also influenced by cataract, diabetic retinopathy and amblyopia. Therefore, nearly one-third of eyes treated had SVI at 12mo postoperatively in our series. This success rate in our study is based on improved vision that could be negatively affected by other comorbidities.

To improve the outcomes of AGV surgery, bovine pericardial graft was used to cover valve without using suture. This enabled to reduce both mean IOP as well as number of medication in refractory glaucoma patients[19].

A number of complications such as hypotony, hyphema, cataract, corneal decompensation, and failure to control IOP, trans-scleral erosion and endophthalmitis (1.7%) are reported after AGVI [10,15,16]. In our series, there were intra- and post-operative complications despite the availability of modern surgical unit manned by expert glaucoma specialists. Patency failure and displaced inner end of the implant were the main complications in our study. Thus, a surgical audit for AGVI must include complications. There should be a proactive plan for additional surgical procedures to address the comorbidities that limit visual gain. The presence of trachomatous scarring and severity of scar was not noted in this study, hence, association of trachoma to success rate could not be determined in this study.

There were some limitations in our study. Nearly 25% of the participants in our study were lost to follow up both at 4wk and 56wk postoperatively. The loss to follow up is a serious bias in any longitudinal study and epidemiologists have suggested methods to minimize their influence on outcomes[17]. Large sample and comparing profile of those undergoing follow-up to those lost to follow-up are methods to address this limitation. Our study had small sample size. However enrolling a large cohort does not guarantee good follow up. For example, Das *et al*[13] enrolled a large cohort of patients and reported participation rates of 53% at 12mo and 43% at 24mo. We assumed that the success rate among those who presented for follow-up was similar to those who were lost to follow up. However, refractory glaucoma patients who are not satisfied with the outcomes especially the alleviation of symptoms may present for second opinions to other physicians. Thus, the success rate presented could be under-estimated by 25% if we assume that those lost to follow up were not successful. Most of patients in our study were adults with the exception of three patients with refractory glaucoma secondary to congenital glaucoma. Hence, our series was likely a greater indication of adult-type glaucoma.

In this study of refractory glaucoma among people in the eastern province of Saudi Arabia, the success of reducing IOP, reducing the number of medications following AGVI was promising but lower than previous literature reports. For example, complications were higher and eyes with stable visual acuity at 56wk postoperatively were lower. Long-term follow-up of eyes with refractory glaucoma managed by AGVI is recommended.

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Conflicts of Interest: Alasbali T, None; Alghamdi AA, None; Khandekar R, None.

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