Original Article

Risk Factors for Ahmed Glaucoma Valve (AGV) Failure in Glaucoma Patients

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Abstract

Background: To investigate the Risk factors for AGV (Ahmed glaucoma valve) failure.
Material and Methods: A retrospective review was conducted on the medical records of patients with varying causes of glaucoma who had undergone AGV implantation. The primary measure of success was the cumulative achievement of an intraocular pressure (IOP) between 5 and 21 mmHg, with a 20 % reduction from baseline, with or without medication to lower IOP. The secondary measures of success were the IOP levels and the number of medications used for glaucoma treatment.
Results: The study enrolled a total of 120 participants, with an average age of 48.9 ± 19.6 years and an average follow-up period of 4.5 ± 1.4 years. The mean survival duration was 5.3 ± 0.5 years in patients with high pressure (HP), which was significantly shorter than the 6.4 ± 0.2 years in those without HP. The likelihood of surgical failure increased with higher baseline IOP, with an odds ratio of 1.07 (95 % confidence interval: 1.02-1.12). In a logistic regression model, neovascular glaucoma was the only factor significantly associated with the occurrence of HP, with an odds ratio of 3.14 (95 % confidence interval: 1.2-8.1).
Conclusion: Neovascular glaucoma and a Higher Baseline IOP are risk factors for AGV failure.

Keywords: Ahmed Glaucoma Valve, Success Rate, Intraocular Pressure.

Article Notes: Received: Jan. 23, 2021; Received in revised form: Feb. 13, 2021; Accepted: Aug. 23, 2021; Available Online: Aug. 28, 2021.

How to cite this article: Yadgari M, Nilforushan N, Mahmoudi Nejad Azar S. Risk factors for Ahmed Glaucoma Valve (AGV) Failure in Glaucoma Patients. Journal of Ophthalmic and Optometric Sciences . 2021;5(3): 19-24.

Introduction

In recent years, glaucoma drainage devices (GDDs) have become a popular option for surgical management of patients with refractory glaucoma or unsuccessful prior glaucoma surgeries. However, recent research studies have found that primary GDD implantation in glaucoma patients has a lower success rate than trabeculectomy [1, 2].

Several risk factors for the development of HP (hypertensive phase) have been reported in previous studies, including higher baseline intraocular pressure (IOP) [3], the type and material of the device [4], the opening and closing pressure of the tube, which are intrinsic characteristics of the device [5], and longer axial length[6]. It has also been found that HP can result in short-term and long-term failure of AGV (Ahmed glaucoma valve) [6].

Compared to patients who underwent Bearveldt Glaucoma Implantation (BGI), Tsai et al.[7] reported a significantly higher mean IOP after one month following Ahmed Glaucoma Valve (AGV) implantation. The Ahmed versus Baerveldt [8] study and the Ahmed and Baerveldt comparison [9] study both found that the AGV group had higher IOPs one month after the operation, but the AGV group had lower IOPs on the first day and one week after surgery. Similarly, the use of the Molteno device has been associated with lower IOPs compared to AGV [10].The present study aimed to investigate the Risk factors for AGV (Ahmed glaucoma valve) failure.

Material and Methods

The current study involved a retrospective review of the medical records of all glaucoma patients who underwent AGV implantation between January 2010 and January 2019. These surgeries were performed at two educational glaucoma practice centers and were approved by a local ethics committee in compliance with the principles of the Declaration of Helsinki. The study included patients who had undergone AGV implantation and were followed up for at least 3 years, while those who were under 18 years of age or had undergone any intraocular surgery were excluded. The main outcome measure was defined as cumulative success, which required an IOP between 5 and 21 mmHg with a 20 % reduction from the baseline, with or without IOP-lowering medications. The secondary outcome measures were the IOP and the number of glaucoma medications during the postoperative follow-up period.

Surgical technique and postoperative visits

The surgeries were performed by two glaucoma specialists (NN, MY) who followed a standardized technique. The AGV (model FP7, New World Medical, Rancho Cucamonga, CA, USA) was primed and secured to the sclera with an 8-0 nylon suture, about 10 mm behind the surgical limbus, after making a superotemporal quadrant-based conjunctival flap under general or local anesthesia. The tube was inserted into the anterior chamber using a 23-gauge needle, and a scleral patch graft (5 * 5 mm) was used to cover the anterior part of the tube. An 8-0 Vicryl suture was used to secure the conjunctiva, and subtenon Methylprednisolone was administered as the final step. Postoperative treatment included Ciprofloxacin eye drops four times a day for 10 days and Betamethasone eye drops every two hours for two weeks, with tapering over 8-12 weeks based on the inflammation level in the surgical area. Patients were examined on postoperative day 1, weekly for 4 weeks, and then every 1-3 months based on clinical judgment. Glaucoma medications were initiated in a stepwise manner if the target

pressure was not achieved or when HP was diagnosed, with aqueous suppressants being the first choice if no contradictions were present.

Data gathering

The patient records were reviewed and the following information was extracted: age, sex, type and stage of glaucoma, pre- and post-operative intraocular pressure (IOP), number of medications, any intraoperative or postoperative complications, previous intraocular surgeries, and any associated systemic diseases.

Statistical analysis

The study's primary goal was to measure success in treating glaucoma by assessing intraocular pressure (IOP) reductions of at least 20 % compared to the baseline level, with or without medication, and an IOP range of 5 to 21 mm Hg. Secondary outcomes were IOP and the number of glaucoma medications used. Variables with a normal distribution, such as IOP, were presented using the mean, while variables without normal distribution, such as glaucoma medication, were presented using the median. The obtained data was described using frequency and standard deviation. Linear mixed models were employed to assess changes in IOP and glaucoma medication at various intervals. To compare IOP and glaucoma medications between the groups, the student T-test and Mann-Whitney were respectively used. Success was defined as achieving an IOP range of 5 to 21 mmHg and a 20 % reduction from the baseline level without medication, whereas qualified success was defined in the same way, but with the use of anti-glaucoma medication.

Results

In this study, 120 patients were included and their records were reviewed. The mean duration of follow-up was 4.5 ± 1.4 years. The study participants had an average age of 48.9 ± 19.6 years (ranging from 1 to 88), and their demographic data is presented in Table 1. The postoperative visits at 1, 2, 3, and 4 years showed that the mean IOP and number of IOP lowering agents were higher in HP patients than in non-HP patients, with all Ps being less than 0.01. Additionally, a higher baseline IOP was significantly associated with higher surgical failure rates. Logistic regression analysis revealed that neovascular

Table 1: Characteristics of the study participants

		Group with HP	Group without HP	P value
Age	Years	47.3 ± 18.5	49.5 ± 20.0	0.61
Sex	Male (N, %)	13 (48.1 %)	56 (60.8 %)	0.19
	Female	15 (51.9 %)	36 (39.1 %)	
Glaucoma type	POAG	2 (7.1 %)	19 (15.8 %)	0.12
	CACG	2 (7.1 %)	9 (7.5 %)	
	PCG	4 (14.3 %)	5 (4.1 %)	
	NVG	11 (39.3 %)	16 (13.3 %)	
	Other	9 (32.1 %)	71 (59.2 %)	

POAG: Primary open-angle glaucoma; CACG: chronic angle-closure glaucoma; PCG: Primary congenital glaucoma; NVG: Neovascular glaucoma

glaucoma was the only factor associated with the occurrence of HP. Tables 2 and 3 provide further details on these findings.

Complications

In this study, five patients experienced tube exposure. Choroidal detachment occurred in five patients, with four patients receiving conservative treatment and one requiring choroidal drainage. Additionally, two patients who were managed conservatively showed corneal decompensation.

Discussion

According to histopathological studies investigating the wound healing process after GDD implantation, there is a difference between staged procedures and procedures where aqueous flow is immediately established, such as AGV. It has been suggested that the mechanical pressure of aqueous or the presence of cytokines in the anterior chamber may lead to the formation of a full-thickness, thick bleb wall around the plate [11].

The occurrence of HP typically peaks after one month, which corresponds to the timing of fibrosis formation around the AGV plate. However, Jung et al [12]. used anterior segment optical coherence tomography to demonstrate a thinner wall of the bleb that corresponds to the age of HP and proposed that collagen cross-

Table 2: Results of regression model predicting factors affecting surgical failure in total patients

Variable	Hazard Ratio	Confidence Interval 95 %		P value
		Lower band	Upper band	
Age	0.99	0.96	1.02	0.65
Sex	1.0	0.39	2.51	0.99
Glaucoma Type	0.76	0.23	2.44	0.65
Presence of HP	2.17	0.83	5.71	0.11
Baseline Medication	2.41	0.96	6.05	0.06
Baseline IOP	1.07	1.02	1.12	0.002*

*Based on the Cox Proportional Hazard Regression Model, backward Wald

Table3: Results of the regression model predicting factors affecting the presence of HP in total patients

Variable	Hazard Ratio	Confidence Interval 95 %		P value*
		Lower band	Upper band	
Age	.986	.962	1.010	0.98
Sex	1.931	.792	4.711	0.14
Glaucoma Type**	3.143	1.216	8.119	0.018
Baseline Medication	1.119	.724	1.730	0.61
Baseline IOP	1.002	.948	1.060	0.93

*based on binary logistic Regression, backward Wald.

**Categorical variable, neovascular glaucoma, or not.

linking is responsible for the pathophysiology of thinner blebs and HP. Additionally, the study found that approximately two-thirds of patients did not experience resolution of HP, and all HP patients required glaucoma medication in the first year.

It was indicated that more prevalent inflammatory cytokines in the aqueous of patients with NVG [13] could contribute to a more prominent fibrovascular response; therefore, they might be the underlying mechanism. Lower preoperative IOP, neovascular glaucoma and younger age were predictors of tube shunt failure in Bowden's study [13] that confirm our result about neovascular glaucoma as a risk factor for AGV failure. However, we did not identify other items as risk factors.

Our limitations are also included, but they are not limited to the retrospective nature of the study, the small sample size, and the varieties of glaucoma.

Conclusion

Neovascular glaucoma and higher preoperative intraocular pressure are risk factors for AGV implantation surgery failure.

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Footnotes and Financial Disclosures

Conflict of interest:

The authors have no conflict of interest with the subject matter of the present manuscript.