ORIGINAL ARTICLE

SURGERY OUTCOMES OF GLAUCOMA DRAINAGE DEVICE IMPLANTATION IN REFRACTORY GLAUCOMA PATIENTS AT SARDJITO GENERAL HOSPITAL

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ABSTRACT

Introduction: *Glaucoma drainage device (GDD) implantation was an effective surgical procedure in treating uncontrolled intraocular pressure (IOP) of glaucoma patients in certain complicated conditions. GDD implants were classified into valved and non-valved in which its surgical outcomes in different types of device and various etiologies were not similar. This study aimed to evaluate the surgery outcomes of GDD implantation in patients with refractory glaucoma at Sardjito General Hospital.*

Methods: *All 12 eyes of 11 patient's medical records who underwent GDD implantation during 2022 at Sardjito General Hospital was reviewed. Baseline data include age, gender, eye laterality, type of glaucoma, IOP and visual acuity. The IOP and visual acuity (LogMAR) were measured at week 1, month 1, 2 and 3. Type of GDD implants, postoperative glaucoma medications, complications and need for further glaucoma surgery were documented.*

Results: *The mean IOP at baseline was 44 ± 14.2 mmHg with 3.4 ± 0.6 glaucoma medications. It decreased after surgery into 19.1 ± 11.2 mmHg (p=0.003) at 3 months follow up with 0.7 ± 1.7 (p=0.002) glaucoma medications. The mean initial visual acuity was 1.9 ± 0.6 and changed insignificantly to 1.7 ± 0.8 (p=0.624) at last follow up. Six eyes (50%) were implanted with valved implant. The most common early postoperative complications were recurrent high IOP (4 eyes, 33.3%) associated to ripcord of non-valved implant (p=0.025). Five eyes (41.7%) needed additional surgery related to non-valved implant type (p=0.003).*

Conclusion: *GDD implantation especially valved type appears to be safe and effective surgical option in treating refractory glaucoma patients*

Keywords: *Glaucoma drainage device, refractory glaucoma, glaucoma surgery, intraocular pressure*

INTRODUCTION

Glaucoma is one of the world's leading cause of irreversible blindness. It affects more than 76 million people worldwide and estimated to be 111.8 million peoples in 2040.[1] It is about 8.4 million people who are blind as the result of glaucoma.[2] In Indonesia, based on Riskesdas 2007 the prevalence of glaucoma is 0.46% which means that in every 4 to 5 of 1000 peoples in Indonesia had glaucoma. It is the second most causative of blindness in Indonesia after cataract.[3]

Glaucoma that are unresponsive to medical treatment or conventional glaucoma surgical procedures can be defined as refractory glaucoma including neovascular glaucoma, uveitic glaucoma, angle recession, and another secondary glaucoma.[4] The only proven method to

prevent the development and to slow the progression of glaucomatous optic neuropathy is lowering intraocular pressure (IOP) using IOP lowering agent drugs or surgery.[5]

Various surgical approaches have been proposed for treating refractory glaucoma such as trabeculectomy with adjunctive anti metabolites, cyclodestructive procedures, and glaucoma drainage devices (GDD).[6] The use of glaucoma drainage implants has increased in recent years since it is an effective surgical procedure in treating uncontrolled IOP in certain complicated glaucoma conditions.[5]

GDD implants are classified into valved and non-valved depending on whether or not a valve mechanism is present that limits flow through the tube to the plate if the IOP becomes too low. The current common used non-valved GDD is Baerveldt glaucoma implant and Molteno implant while valved GDD are Ahmed glaucoma valve and Krupin slit valve.[7] Among those GDD types have its own surgical outcomes correlates to the various etiologies of glaucoma type. This study aimed to evaluate the surgery outcomes of GDD implantation in patients with refractory glaucoma at Sardjito General Hospital.

METHODS

This retrospective observational study reviewed medical records of all refractory glaucoma patient who underwent GDD implantation from January to December 2022 at Sardjito Eye Center, Dr. Sardjito General Hospital, Yogyakarta, Indonesia. Total 12 eyes of 11 patients were included to this study.

Baseline data consisting age, gender, eye laterality, type of glaucoma, visual acuity, and IOP were collected. The visual acuity was measured using Snellen vision chart and for numerical analysis it was converted into logarithm of minimum angle resolution (logMAR). The patients IOP was assesed using non-contact tonometer (NCT) Shin Nippon N-10. The IOP and visual acuity were measured at week 1, month 1, 2 and 3. Type of glaucoma included was primary glaucoma (primary open angle, juvenile open angle and angle closure glaucoma) and secondary glaucoma (neovascular, post vitrectomy and uveitic glaucoma). Type of GDD implants, postoperative glaucoma medication numbers, complications and need for further glaucoma surgery were documented. The GDD implants used were valved Ahmed implant and non-valved implant including Virna, Paul and Aurolab Aqueous Drainage Implant (AADI).

Surgical outcomes were divided into 3 categories by the range of postoperative IOP. The complete success defined as IOP range 6–20 mmHg or IOP decrease from baseline by 30%. The qualified success was for the patients with IOP range 6–20 mmHg or IOP decrease from baseline by 30% with anti glaucoma medication. If the IOP below 6 mmHg or higher than 21

mmHg even with anti glaucoma medication and loss of light perception of vision, the patients was included into failure group.

Statistical Analysis

Baseline data characteristics were presented by descriptive statistics: continuous variables as the mean and standard deviation (SD), and categorical variables as frequency and percentage. The visual acuity, IOP and the number of glaucoma medication prescribed were compared between preoperative and postoperative using paired t test for parametric data and wilcoxon for nonparametric data. The coefficient contingency correlation test was used to analyzed the correlation between baseline data to complications occurred, need for further surgery and additional glaucoma medication. A *p*-value less than 0.05 was considered statistically significant. All statistical analyses were performed with IBM SPSS Statistics Version 22.

RESULTS

A total of 12 eyes of 11 patients were included. The demographic data and preoperative characteristics of the patients are presented in Table 1. The mean patient age was 47.9 ± 19.4 years (range 9–67). Six patients (50%) were female. Glaucoma diagnosis type were divided into primary glaucoma 4 patients (33.3%) and secondary glaucoma 8 patients (66.7%). The mean initial visual acuity was 1.8 ± 0.6 logMAR. The mean IOP at baseline was 44 ± 14.2 mmHg with average patient's medications was 3.4 ± 0.6 glaucoma drugs that been consumed including topical and systemic drugs.

Table 1. Baseline Characteristics (n=12)

Characteristics	n	%
Age, y	47.9 ± 19.4	
Gender		
Male	6	50
Female	6	50
Eye Laterality		
Right	6	50
Left	6	50
Glaucoma Type		
Primary Glaucoma		
POAG	1	8.3
JOAG	2	16.7
ACG	1	8.3
Secondary Glaucoma		
NVG	6	50
Uveitic	1	8.3
Post vitrectomy	1	8.3
Preoperative		
Visual Acuity, logMAR	1.8 ± 0.6	
IOP, mmHg	44 ± 14.2	
Medication Number	3.4 ± 0.6	

POAG, primary open angle glaucoma; JOAG, juvenile open angle glaucoma; ACG, angle closure glaucoma; NVG, neovascular glaucoma; IOP. Intraocular pressure

Six patients (50%) were implanted with valved Ahmed implants while others received non-valved implants including Virna, Paul and AADI implant for 3 (25%), 1 (8.3%), and 2 (16.7%) patients respectively. The postoperative data was shown in Table 2. The visual acuity post implant surgery was decreasing into 1.7 ± 0.8 logMAR at the last 3 months follow up. However, this changing were not significantly different compared to the initial preoperative visual acuity (p=0.624). The IOP of the patients post surgery were significantly decreasing at the first week follow up until the last 3 months becoming 11.2 ± 7.4 (p=0.002) and 19.1 ± 11.2 (p=0.003) respectively. The changes of the visual acuity and IOP were shown in Figure 1 and 2. The need of glaucoma medication number was also decreased into 0.67 ± 1.07 (p=0.002).

Table 2. Postoperative Data

Characteristics	n	%	*p*
GDD Implant Type			
Valved			
Ahmed	6	50	
Non-valved			
Virna	3	25	
Paul	1	8.3	
AADI	2	16.7	
Visual Acuity, logMAR			
Week 1	2.1 ± 0.7		0.401
Month 1	1.8 ± 0.7		0.944
Month 2	1.9 ± 0.6		0.933
Month 3	1.7 ± 0.8		0.624
IOP, mmHg			
Week 1	11.2 ± 7.4		0.002
Month 1	22.9 ± 17.7		0.008
Month 2	17.3 ± 8.9		0.000
Month 3	19.1 ± 11.2		0.003
Medication Number	0.67 ± 1.1		0.002
Complication	8	66.7	
FAC	3	25	
Tube exposure	1	8.3	
Ripcord occlusion	4	33.3	
Additional Surgery	5	41.7	
Glaucoma Type			0.679
Primary Glaucoma	2	16.7	
Secondary Glaucoma	3	25	
GDD Implant Type			0.003
Valved	0	0	
Non-valved	5	41.7	

GDD, glaucoma drainage device; AADI, Aurolab aquous drainage implant; IOP, intraocular pressure; FAC, flat anterior chamber

The early implant surgery complication occurred to 8 patients (66.7%). The most common complication was ripcord tube occlusion of non-valved implant causing high IOP post surgery that happen in 4 patients (33.3%). Flat anterior chamber (FAC) occurred to 3 patient (25%) and another 1 patient (8.3%) had implant tube exposure post surgery. Five patients (41.7%) need further additional surgery to treat the complications occurred and all of this patients were implanted with non-valved implants.

Based on patient's post operative IOP, the surgery outcomes could be classified into complete success in 7 patients (58.3%), qualified success in 2 patients (16.7%) and failure in 3 patients (25%).

The correlation between patients characteristics including sex, eye laterality, implant type and glaucoma type to the incidence of complication and to the need of further surgery were all insignificantly correlates unless for the implant type with p=0.025 and p=0.003 respectively. To the need of glaucoma medication post surgery, the characteristics that significantly correlates were the implant used (p=0.049) and the glaucoma type diagnosis (p=0.015).

DISCUSSION

Glaucoma drainage device implantation has become a procedure of choice in refractory glaucoma cases with comparable or higher success rates compared with conventional trabeculectomy surgery. A systematic review and meta-analysis from Hai Bo et al that comparing the efficacy of valved GDD implantation with conventional trabeculectomy surgery reported the cumulative probability of complete and qualified success of the Ahmed valved implant was 51%, which was comparable with 55% from trabeculectomy.[8] It had also lower adverse events than trabeculectomy at the follow-up.

In our study, the visual acuity at the first week follow up was worsen from preoperative 1.8 ± 0.6 logMAR into 2.1 ± 0.7 logMAR. This decreased result was related to the acute local inflammation following surgery. Afterward in the next follow up at month 1, 2 and 3, the visual acuity were back and steady at around the initial preoperative visual acuity. Generally, the patients visual acuity changing were not significant before and after GDD implant surgery. It might happen because the worse average initial visual acuity of the patients (1.8 ± 0.6 logMAR) which equal to counting finger 1 meter. Most of our patient's glaucoma status were in advanced stage. This result was consistent to the similar previous study in Thailand in 2022 by Rojananuangnit.[8]

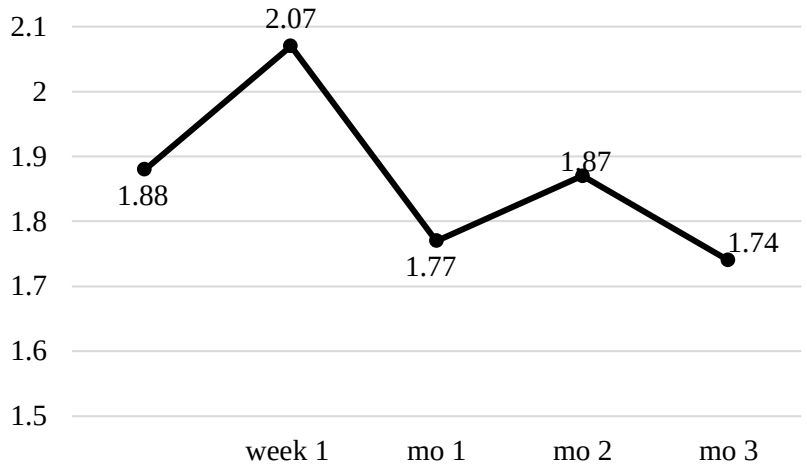

Figure 1. **Visual acuity changes during follow up (logMAR)**

The complete success in lowering IOP post implant surgery could be observed in 58.3% subject. The average IOP during follow up in week 1, month 1, 2 and 3 were always in range 6–20 mmHg or decrease from baseline by 30%. This results were significantly different compared to the initial preoperative IOP showing the effectiveness of the GDD implant surgery.

In our study, we found the IOP of the first month follow up post surgery was sightly increased becoming 22.9 ± 17.7 mmHg compared to the week 1 follow up (11.2 ± 7.4 mmHg). In the next month follow up, the IOP started decreasing again into 17.3 ± 8.9 mmHg and maintained steady afterward. This increase seemed to be correlated to the hypertensive phase which refers to a transient elevation of IOP following GDD implant surgery. This was a common observation result and had incidence ranging from 40-80%.[9]

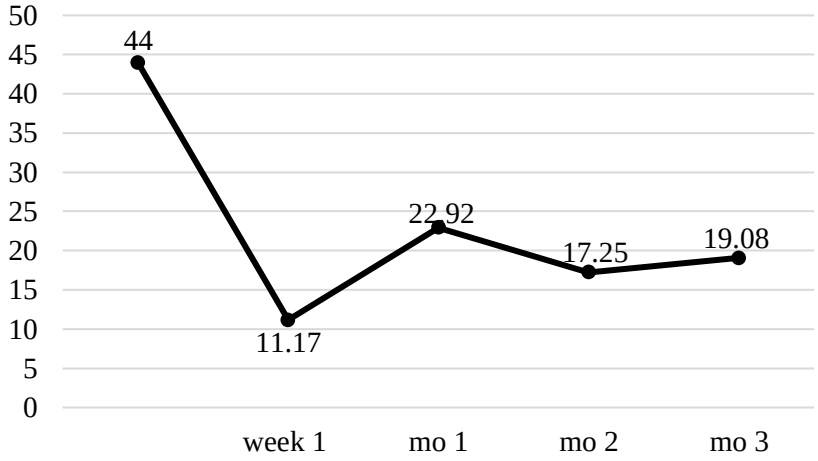

Figure 2. The IOP changes during follow up (mmHg)

Two cases (16.7%) of our subjects need to consume additional glaucoma medication to maintain the postoperative IOP stayed in normal range. Another 25% subjects (3 cases) had

IOP higher than 21 mmHg even with anti-glaucoma medication and included into failure category. However, the number of medication needed was decreased significantly from 3.4 ± 0.6 preoperative into 0.67 ± 1.1 postoperative (p=0.002).

Glaucoma drainage implants have similar operative and postoperative complications as encountered with trabeculectomy, but there are other unique complications associated with their use. It was reported before that the postoperative complication rate was 52%.[5] At last follow-up, we found a postoperative complication rate of 66.7%.

The common early postoperative complication encountered was flat anterior chamber (FAC). The incidence in the reported previous surgery was 4.18%.[10] In our study, FAC could be found in 3 cases (25%).

Tube exposure is a well-known complication of glaucoma drainage implants. Frequency of tube exposure varies from 5% to 14.3% of cases. Tube exposure represents a major risk factor for the development of late endophthalmitis, as the exposed tube provides a way for microorganisms to migrate into the eye from ocular surface and conjunctiva.[11] In this study, we found 1 case (8.3%) of tube exposure after implantation.

Non-valved implants initially had a relatively high rate of postoperative hypotony until techniques were developed to temporarily restrict aqueous flow through the device. Methods for flow restriction include tube ligation with a polyglactin (Vicryl) or prolene suture, or tube obstruction with a collagen plug or luminal suture.[7] Sometimes, this temporarily restriction caused the implant to be non-functional and needed additional action to remove the restriction. In our study, there was 4 cases (33.3%) of the persistent high IOP post surgery associated to this condition and need further ripcord removal surgery.

The efficacy and safety of GDD implantation varied along with different types of GDD model and various underlying glaucoma etiologies. There was the Ahmed-Baerveldt Comparison (ABC) study which compared both efficacy and safety between the Ahmed valved implant and non-valved Baerveldt implant. The surgical rates between valved and non-valved GDD comparing between primary and secondary glaucoma were not different in ABC study while the failure was found more in non-valved implant.[8] In our study, 41.7% subjects (all with non-valved implant) needs additional surgery to threat the failure and complications occurs.

Glaucoma etiology could be the predictor for surgical success or failure in GDD implantation as primary glaucoma had a significantly higher success rate than secondary glaucoma.[8] Case series studying glaucoma drainage implants have reported success rates ranging from 22% to 78% for neovascular glaucoma, 75% to 100% for uveitic glaucoma, 44% to 100% for developmental glaucoma, 50% to 88% for eyes that have undergone cataract

surgery and 44% to 88% for eyes with failed glaucoma filtering surgery.[7] The poorest surgical results are observed in neovascular glaucoma.[8] In our study, the failure occurred in JOAG and uveitic glaucoma patients. However, the complications mostly appeared in secondary glaucoma: neovascular glaucoma (3 cases, 25%), uveitic glaucoma (1 case, 8.3%), secondary glaucoma post vitrectomy (1 case, 8.3%) compared to primary glaucoma: JOAG (2 cases, 16.7%), angle closure glaucoma (1 case, 8.3%).

The limitation of this study were small sample size of the study because of the limited patients underwent GDD implant surgery during 2022 related to post Covid 19 pandemi. This study might need longer follow-up period which allows an assessment of long-term outcome. However, it was important to note that all surgical procedures were performed only by 2 surgeon. The inclusion of subjects with various glaucoma type diagnoses and the variety of used GDD type could enlarge the data and subject included.

CONCLUSION

Surgery of GDD implantation appears to be safe and effective surgical option in treating refractory glaucoma patients. The surgery outcome of GDD implant was better in primary glaucoma than secondary glaucoma. The common early postoperative complications was recurrent high IOP associated to ripcord of non-valved implant, FAC related to hypotonia and tube exposure. The valved glaucoma implant had lower complication and lower additional surgery need compared to non-valved implant.

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