

ORIGINAL ARTICLE

**TRABECULECTOMY VERSUS TUBE OUTCOME IN
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ABSTRACT

Introduction and Objective: Neovascular glaucoma (NVG) is known to be a refractory form of glaucoma, which frequently requires the integrated use of medical, laser and incisional surgery. Tube-shunt implantation and trabeculectomy with anti-fibrotic agent are the two most-popular incisional procedures for managing refractory glaucoma. This study aims to compare surgical outcome between patients who underwent trabeculectomy versus tube-shunt implantation for the treatment of NVG.

Methods: A retrospective study was held of NVG patients that underwent trabeculectomy and tube-shunt implantation between January 2020 - December 2022 at Dr. Kariadi Hospital, Semarang. IOP outcome and success rate was measured at 3 months post operatively. Statistical analysis was used to compare the outcome between groups, $p < 0.05$ was considered significant.

Result: There were no significant differences in characteristics between groups at baseline. Mean IOP measured at 3 months postoperatively was 18.58 ± 5.53 and 15.94 ± 10.79 in trabeculectomy and tube group respectively ($p=0.04$), complete success rate was 18.8% in trabeculectomy and 25% in tube group, qualified success rate was 37.5% in trabeculectomy and 56.3% in tube group. Greater failure rate was observed in trabeculectomy group (43.8%).

Conclusion: Compared to trabeculectomy, tube-shunt implantation has lower IOP at 3 months postoperatively in NVG. Similar number of anti-glaucoma medications was needed postoperatively in both procedure. Greater qualified success rate was achieved in tube-shunt implantation. Greater failure rate was observed in trabeculectomy.

Keywords: Neovascular glaucoma, Trabeculectomy, Tube-shunt surgery

INTRODUCTION

Neovascular glaucoma (NVG) is a secondary ocular disorder resulted from a variety of ocular pathologies, with retinal ischemia as the underlying mechanism in nearly all cases. Retinal ischemia leading to an impaired homeostatic balance between the angiogenic and antiangiogenic factors. High concentrations of vasogenic substances induce neovascularization of the iris (NVI) and neovascularization of the angle (NVA) that limits the outflow of aqueous humor from the anterior chamber, leading to the intraocular pressure (IOP) increment.^{1,2}

NVG is known to be a refractory form of glaucoma, which frequently requires the integrated use of medical, laser and incisional surgery. Adequate control of IOP is necessary in conjunction to retinal ischemic disease control.²⁻⁴ Tube-shunt implantation and trabeculectomy

with antifibrotic agent are the two most-popular incisional procedures for managing refractory glaucoma. Several studies has been reported the effect of trabeculectomy and tube-shunt implantation for the treatment of NVG, but study comparing surgical methods for the treatment of NVG is limited.⁴⁻⁷ This study aims to compare surgical outcome between patients who underwent trabeculectomy versus tube-shunt implantation for the treatment of NVG.

METHODS

This was a single-center, retrospective, comparative study of NVG patients that underwent trabeculectomy with anti-fibrotic agent and tube-shunt implantation between January 2020 - December 2022 at Dr. Kariadi Hospital, Semarang, Indonesia with a minimum 3 months follow up. The patients who had not been seen for follow-up and medical records with incomplete patient data were excluded from the study. The patient data were collected from the medical record in the hospital database. The study was approved by the Institutional Review Board.

Preoperative information included patient age, sex, history of PRP and anti-VEGF injection, etiology of NVG, pattern of neovascularization, anti-glaucoma medications (AGM), and IOP measured by non-contact tonometry.

All procedures were performed and managed by 3 glaucoma specialists. A fornix-based approach and anti-fibrotic agent was used when trabeculectomy performed.

Postoperative data regarding IOP, AGM, and complications were obtained on days 1, 7, and months 1, and 3. The primary outcome measures were IOP, number of postoperative AGM, and surgical success. Success rate measured at 3 months post operatively was categorized into 3: IOP \leq 21 mmHg without AGM as complete; IOP \leq 21 mmHg with AGM as qualified; IOP $>$ 21 mmHg as failure.

Potential postoperative complications for either procedure, including hyphema, infection, choroidal effusions, early hypotony, bleb/wound leak, strabismus, and suprachoroidal hemorrhage, were assessed. Early hypotony was defined as an intraocular pressure (IOP) $<$ 6.5 mmHg during the first postoperative week.

Patient characteristics were described using descriptive statistics. The complications were defined as being present or absent at any time of follow-up and the number of occurrences. Statistical analysis using SPSS V23.0 to compare the outcome between groups. The Mann–Whitney test was used for continuous variables, and the χ^2 and Fisher exact test for categorical data. $P < 0.05$ was considered significant.

RESULTS

During January 2020 - December 2022 there were 34 eyes of 34 patients treated with trabeculectomy with anti-fibrotic agent (18 eyes) or tube-shunt surgery (16 eyes). Two patients were excluded due to lost to follow up post trabeculectomy. A total of 32 eyes were enrolled to the study. The preoperative data for the two groups are shown in Table 1. There were no significant differences in characteristics between groups at baseline.

Table 1. Preoperative characteristics of patients

	Trabeculectomy (N=16)	Tube-shunt (N=16)	P value
Age (years), Mean \pm SD	54.44 \pm 8.59	54.06 \pm 12.32	0.925 [‡]
Sex, n(%)			
Male	4 (25%)	9 (56.3%)	0.150 [¥]
Female	12 (75%)	7 (43.8%)	
NVG Etiology, n(%)			
PDR	13 (81.3%)	10 (62.5%)	0.388 [¶]
CRVO	3 (18.8%)	5 (31.3%)	
Cause unknown	0 (0%)	1 (6.3%)	
NVI, n(%)			
Present	14 (87.5%)	15 (93.8%)	0.500 [£]
Absent	2 (12.5%)	1 (6.3%)	
NVA, n(%)			
Present	8 (50%)	8 (50%)	1.000 [¥]
Absent	8 (50%)	8 (50%)	
Preoperative anti-VEGF, n(%)			
Yes	12 (75%)	11 (68.8%)	0.500 [£]
No	4 (25%)	5 (31.3%)	
Preoperative PRP, n(%)			
Yes	12 (75%)	10 (62,5%)	0,703 [¥]
No	4 (25%)	6 (37,5%)	
Baseline ocular characteristics, mean \pm SD			
IOP (mmHg)	42.14 \pm 8.07	40.88 \pm 7.81	0.656 [§]
AGM	2	2	1.000

PDR= proliferative diabetic retinopathy; CRVO= central retinal vein occlusion.

[‡] Mann-Whitney; [¥] Continuity Correction; [£] Fisher's exact; [¶] Pearson Chi-Square; [§] Independent t

Table 2 shows the mean pre and postoperative IOP in both the trabeculectomy and tube-shunt group. In both groups, the mean postoperative intraocular pressures at all follow-up time points were lower than the mean preoperative intraocular pressure. The mean IOP was significantly lower in tube-shunt group at 3 months post operatively.

Table 2. Intraocular Pressure (IOP) Pre- and Postoperative

	Trabeculectomy (N=16)	Tube-shunt (N=16)	P value
Pre (mmHg)	42.14 ± 8.07	40.88 ± 7.81	0.656 [§]
1 Day (mmHg)	16.63 ± 10.87	21.40 ± 13.68	0.327 [‡]
7 Day (mmHg)	14.54 ± 8.91	18.49 ± 12.93	0.509 [‡]
1 Month (mmHg)	19.70 ± 7.74	18.49 ± 7.98	0.497 [‡]
3 Months (mmHg)	18.58 ± 5.53	15.94 ± 10.78	0.046 ^{‡*}

[‡] Mann-Whitney; [§] Independent t; * Significant (p<0,05)

Figure 1 shows the mean number of pre- and postoperative AGM in both groups. Both procedure produce lower AGM needed postoperatively. There was no statistically significant difference between both groups at any postoperative time points.

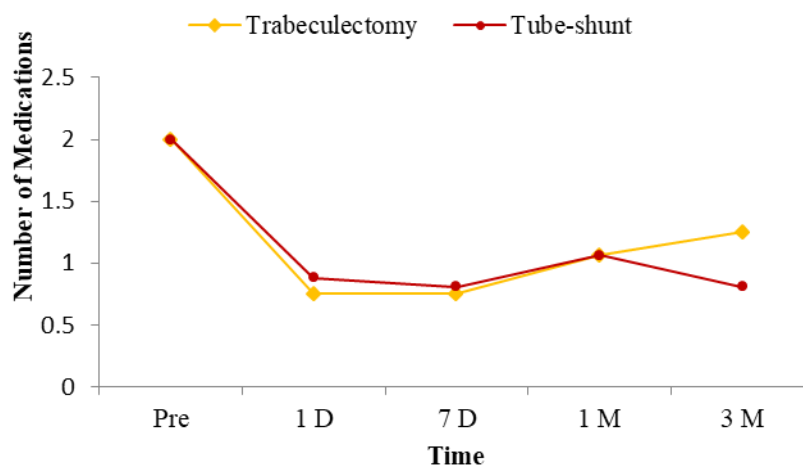


Figure 1. Mean number of pre- and postoperative AGM. There was no statistically significant difference between both groups at any postoperative time points.

The success rate at 3 months post operatively of both groups showed at table 3. Greater qualified success rate was achieved in tube-group (56.3% vs 37.5%). Greater failure rate was noted in trabeculectomy group (43.8% vs 18.8%).

Table 3. Success Rate at 3 Months Post Operatively

	Trabeculectomy (N=16)	Tube-shunt (N=16)
CS	3 (18,8%)	4 (25%)
QS	6 (37,5%)	9 (56,3%)
F	7 (43,8%)	3 (18,8%)

CS = complete success; QS = qualified success;

F= failure

The postoperative complications observed in both groups are summarized at table 4. Hyphaema was the most common complication, occurred in 4 (25%) patients in trabeculectomy group and 3 (18,8%) patients in tube-shunt group.

Table 4. Complications

	Trabeculectomy (N=16)	Tube-shunt (N=16)
Early Hypotony	2	3
Hyphema	4	3
Wound leak	0	0
Shallow anterior chamber	0	0
Endophthalmitis	0	0
Suprachoroidal haemorrhage	0	0
Choroidal effusion	0	0
Tube expose	-	0
Tube occlusion	-	0

DISCUSSION

Principles management of NVG are underlying disease control, treatment of retinal ischaemia, IOP control and inflammation control. Surgical management is indicated in NVG patients that are insufficient IOP control despite maximum medical therapy and developed extensive peripheral anterior synechia. Surgical management for NVG patient that is refractory to medical and laser therapy are trabeculectomy with antifibrotics or tube-shunt implantation. Surgical management of NVG however, is challenging mainly due to high risk for failure.^{1, 2, 4}

Our study compare surgical outcome of trabeculectomy with antifibrotic and tube-shunt implantation in NVG management. We observed postoperative IOP outcome in both groups and noted that although IOP observed at 3 months post tube-shunt implantation was significantly lower than that post trabeulectomy, however, there was no significant difference between both groups in all other time points, and the AGM needed postoperatively was similar in both groups. The complete success rate at 3 months postoperatively of 18.8% in trabeculectomy group and 25% in tube group, qualified success rate of 37.5% in trabeculectomy group and 56.3% in tube group. Greater failure rate was noted in trabeculectomy group (43.8% vs 18.8%).

Trabeculectomy alone have a high failure rate due to severe inflammation and hyphema in NVG. Success rate was improved with the use of antifibrotic drug such as mitomycin C or 5-fluorouracyl.^{1,2} Hyung and Kim reported 71% success rate of trabeculectomy with mitomycin

C in NVG at 1 month postoperatively, decreased to 58% at 3 months, and was further decreased to 29% at 12 months postoperatively.⁸ Other studies revealed success rates of trabeculectomy with mitomycin C for managing NVG was ranging from 55,6% to 86,9% at 1 year postoperatively.⁹⁻¹³

Yalvac et. al. in their study reported success rate of Ahmed Glaucoma Valve implantation in 38 NVG patients of 63,3% at 1 year postoperatively.¹⁴

Several studies have been conducted to compare surgical outcomes of trabeculectomy with antifibrotic drug and tube-shunt implantation. Most of them reported similar outcomes between groups. Im et al reported at 2 months post trabeculectomy and Ahmed valve implantation, complete success was 66,7% and 38,5%, and qualified success was 25.9% and 33.3% respectively. At 12 months, complete success was 47.8% and 42.3%, and qualified success was 30.4% and 46.2% in trabeculectomy and Ahmed valve group respectively. The type of surgery had no significant effect on the success rate of neovascular glaucoma treatment at postoperative 12 months.⁷ Tokumo et al performed a prospective, randomized, controlled clinical trial study comparing surgical outcomes of Baerveldt glaucoma implantation versus trabeculectomy for the treatment of NVG. Both procedures produced a significant, sustained reduction of IOP. There were no differences in IOP between the two groups during the follow-up period. No significant differences between the two groups in the number of glaucoma medications at any postoperative time point. Success rates were 59.1% and 61.6% at 1-year post Baerveldt glaucoma implantation and trabeculectomy, respectively. These two procedures produced similar surgical success.⁴ Shen et al conducted a study comparing surgical outcomes in NVG patients who underwent trabeculectomy with mitomycin C versus Ahmed Glaucoma Valve implantation. The mean IOP did not differ statistically between the two groups at any postoperative time point. The trabeculectomy group required a significantly greater number of postoperative medications at months 3 and 6; however, there was no significant difference between both groups in all other time points. Success was 70% and 65% at 1 year post Ahmed Glaucoma Valve and trabeculectomy, respectively. Kaplan–Meier survival curve analysis showed no significant difference in success between the two groups.⁵ Those were contrast to a recent study by Iwasaki et al, comparing surgical outcome in NVG between tube and trabeculectomy. They concluded that Baerveldt glaucoma implant (BGI) surgery had a higher success rate compared with trabeculectomy, and that trabeculectomy was significantly associated with surgical failure.¹⁵

We observed hyphema as the most common complication in both group. Previous study comparing surgical outcome of trabeculectomy and tube-shunt implantation in NVG also noted that hyphema was the most common postoperative complication in both procedure.^{4, 5, 7}

The nonrandomized retrospective design of this study has potential sources of bias. To minimize any bias, patients in each group were matched based on age and sex. The preoperative characteristics in both groups were similar.

Other limitation to our study, the number of patients was small. We conducted this study at a tertiary hospital center for 3 years, however as NVG is a rare condition, we should have conducted this study at a longer time period. Moreover, there were several outpatients excluded from the study due to lost to follow up and incomplete data on medical record.

CONCLUSION

Compared to trabeculectomy, tube-shunt implantation has lower IOP at 3 months post operatively in NVG. Similar number of anti-glaucoma medications was needed postoperatively in both procedure. Greater qualified success rate was achieved in tube-shunt implantation. Greater failure rate was observed in trabeculectomy.

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