

Survival Analysis of Trabeculectomy and Phacotrabeculectomy in Primary Angle Closure Glaucoma

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Abstract

Glaucoma is the global leading cause of irreversible blindness. Primary angle closure glaucoma occurs most frequently in Asian populations, including in Indonesian population. Surgical management of Primary Angle Closure Glaucoma (PACG) includes cataract extraction, trabeculectomy, or combined phacotrabeculectomy. Many patients presented in the advanced stages of the disease with significant cataracts, requiring combined surgery. This study aimed to determine whether trabeculectomy alone was better in reducing intraocular pressure compared to phacotrabeculectomy in primary angle closure glaucoma. This was an analytic retrospective observational study reviewing medical records of PACG patients underwent trabeculectomy or phacotrabeculectomy from January to December 2015, within a 5-year follow-up period of a tertiary eye hospital. The success rates of the two groups were assessed with Kaplan-Meier survival analysis. Success criteria were defined as >20% reduction of IOP or IOP <21 mmHg with or without medication. Results showed 104 and 41 eyes underwent trabeculectomy and phacotrabeculectomy, respectively. The cumulative 5-year survival rate in trabeculectomy group was 58.6%, and 85.4% in phaco trabeculectomy. There was no statistical difference in the success rate between the trabeculectomy and phaco trabeculectomy groups ($p=0.102$). Postoperative complications observed in the phacotrabeculectomy group were one choroidal detachment, one malignant glaucoma, and one vitreous prolapse. Thus, the cumulative success rate of phacotrabeculectomy was better than trabeculectomy after 5 years of follow up, albeit not statistically significant.

Keywords: Intraocular pressure, phacotrabeculectomy, survival analysis, trabeculectomy

Introduction

Glaucoma is a group of optic nerve diseases characterized by progressive damage to retinal ganglion cells. Glaucoma is the leading cause of irreversible blindness globally. Based on national Rapid Assessment of Avoidable Blindness (RAAB) data in 2014–2016, the results showed that 2.8% of Indonesia's population was blind, with a prevalence of blindness due to glaucoma of 2.9%.^{1,2}

The prevalence of glaucomatous optic neuropathy among Asian populations is the second largest in the world. The high number is a result of many cases of primary angle closure

glaucoma that occurred. Primary angle closure glaucoma occurs due to obstruction to the flow of aqueous fluid at the iridocorneal angle.^{1,2,3}

Primary angle closure glaucoma (PACG) occurs due to obstruction of aqueous fluid flow on the iridocorneal angle, resulting in increased intraocular pressure that can ultimately damage the optic nerve. Dense anterior chamber structure, such as large lens size and thickness, and a short anterior chamber are risk factors for closure of the anterior chamber angle, which will lead to increased intraocular pressure and the appearance of glaucoma. Increasing age is one of the predisposing factors for the development of this type of glaucoma.

Treatment in PACG aims to eliminate the angle closure. The options include surgical procedures such as trabeculectomy or a combination of phacoemulsification with trabeculectomy (phacotrabeculectomy). No consensus suggests which surgical procedure is more appropriate.

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Various studies have assessed the efficacy of both procedures based on intraocular pressure reduction and complications. The results obtained show varying results. There has yet to be any research comparing the success of trabeculectomy alone and phacotrabeculectomy in reducing intraocular pressure in patients with PACG at PMN Cicendo Eye Hospital. The current study is anticipated to aid in the selection of a suitable procedure for PACG patients, as demonstrated by previous research.^{4,5} This study aims to determine whether trabeculectomy alone is better in reducing intraocular pressure when compared to phacotrabeculectomy in primary angle closure glaucoma.

Methods

The study was conducted at a tertiary eye hospital in Bandung, Indonesia, after obtaining approval from the ophthalmology department and the Health Research Ethics Committee of PMN RS Mata Cicendo (ethical approval number LB.02.01/II.2/2.3/010/2021). Data collection occurred from March to April 2021. The identities and contents of medical records were kept confidential by the researchers.

This study is an analytic, retrospective observational study based on the medical records of primary angle-closure glaucoma (PACG) patients who underwent trabeculectomy (with an anti-fibrotic agent) or combined trabeculectomy with phacoemulsification, performed by three glaucoma consultants at our hospital from January to December 2015. All samples that met the research criteria were included as study subjects. The inclusion criteria were: (1) trabeculectomy or phacotrabeculectomy performed at Cicendo Eye Hospital, (2) patient age ≥ 40 years, and (3) availability of complete medical record data. Exclusion criteria included patients with a history of other intraocular surgeries and incomplete medical records for the variables assessed in this study, which included age, gender, visual acuity, intraocular pressure, lens status, number of glaucoma medications, and surgical complications.

The success rate in this study was divided into success and failure which were assessed based on the results of the IOP examination and the use of glaucoma medications after surgery. Success was defined if the postoperative IOP decreased $\geq 20\%$ or <21 mmHg with or without the use of glaucoma drugs. Failed was defined if success criteria were unmet or repeated glaucoma

surgery. Postoperative laser suture lysis and bleb needling were not included as failed. The IOP data were taken in 1st week, 1st month, 3rd month, 6th month, 1st year, 2nd year, 3rd year, 4th year and 5th year.

Data analysis to compare the characteristics of the two research groups was performed using the Mann-Whitney test, as the data were not normally distributed. For categorical data, the chi-square test was used, with Exact Fisher or Kolmogorov-Smirnov tests as alternatives. The success rate was assessed using Kaplan-Meier survival analysis, and the two groups were compared with the log-rank test. A p-value of < 0.05 was considered statistically significant. All data were processed and analyzed using SPSS version 24.0 for Windows.

Results

A total of 145 eyes met the inclusion criteria out of 151 cases of primary angle-closure glaucoma (PACG) that underwent glaucoma surgery, either primary trabeculectomy or phacotrabeculectomy. The minimum follow-up period was 1 week, with the longest follow-up extending to 5 years. Primary trabeculectomy was performed on 104 eyes, while primary phacotrabeculectomy was performed on 41 eyes. The demographic characteristics of the study subjects are presented in Table 1.

Clinical characteristics, including the best corrected visual acuity, baseline IOP, cup-disc ratio, and number of medications, are shown in Table 2. Most eyes in the trabeculectomy group had visual acuity of less than counting fingers at 3 m (62,5%). Meanwhile, 41.5% of eyes with visual acuity of less than counting fingers from 3 m were found in the phacotrabeculectomy group. There was no statistically significant difference between the groups.

The mean baseline intraocular pressure (IOP) in the trabeculectomy group was 40.51 ± 15.54 mmHg, which was higher than the mean IOP in the phacotrabeculectomy group. Similarly, the cup-to-disc ratio was larger in the trabeculectomy group compared to the phacotrabeculectomy group. Both differences were statistically significant.

Most eyes in the trabeculectomy (89,4%) and phacotrabeculectomy (100%) had cataracts. There were 11 eyes with clear lenses in the trabeculectomy group. No eyes with clear lens status underwent phacotrabeculectomy. Lens status in both groups was not statistically

Table 1 Demographic Characteristics of Subjects

Variable	Procedure		p-value
	Trabeculectomy n=104	Phacotrabeculectomy n=41	
Age			0.0001*
Mean ± SD	58.59 ± 9.02	66.20 ± 8.95	
Median	57	64	
Range (min-max)	43.00-79.00	49.00-83.00	
Sex			0.002*
Male	22 (21.2%)	19 (46.3%)	
Female	82 (78.8%)	22 (53.7%)	

Note: The p-value for the age variable was calculated using the Mann-Whitney test. Sex was tested using the Chi-square test. The asterisk (*) indicates a statistically significant p-value (<0.05).*

different (p=0.083).

In the phacotrabeculectomy group, three complications were recorded. Choroidal detachment occurred in one eye three months

post-surgery, and malignant glaucoma occurred in another eye one week after the surgery. The third complication was a vitreous prolapse that occurred during the procedure, leaving

Table 2 Clinical Characteristics of Subjects

Variable	Procedure		p-value
	Trabeculectomy n=104	Phacotrabeculectomy n=41	
Visual Acuity			0.148
< 3/60	65 (62.5%)	17 (41.5%)	
<6/60-3/60	6 (5.8%)	4 (9.8%)	
<6/18-6/60	15 (14.4%)	17 (41.5%)	
<6/12-6/18	5 (4.8%)	2 (4.9%)	
≥6/12	13 (12.5%)	1 (2.4%)	
Baseline IOP			0.022*
Mean±SD	40.51 ± 15.54	33.49 ± 13.32	
Median	40	32	
Range (min.-max.)	12.00-80.00	10.00-66.00	
C/D ratio			0.011*
Mean±SD	0.75 ± 0.23	0.66 ± 0.24	
Median	0.8	0.7	
Range (min.-max.)	0.00-1.00	0.00-1.00	
Numbers of Medications			0.998
Mean±SD	2.40 ± 0.58	2.12 ± 0.81	
Median	2	2	
Range (min.-max.)	1.00-4.00	0.00-4.00	

Note: The p-value for visual acuity was tested using the Kolmogorov-Smirnov test. Baseline IOP, C/D ratio, and number of medications were tested using the Mann-Whitney test. The asterisk (*) indicates a statistically significant p-value (< 0.05).*

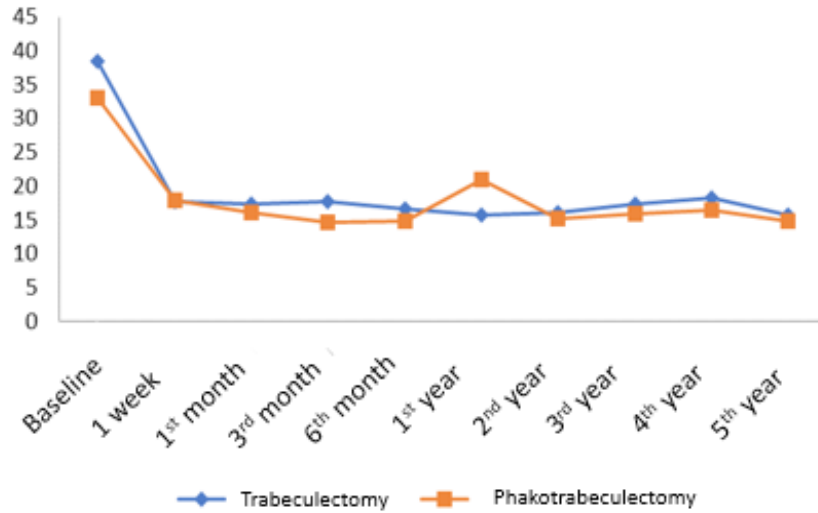


Figure 1 Mean IOP in the Follow-Up Period

the patient aphakic. There was no statistical difference between the two groups ($p=0.051$).

Figure 1 shows the mean postoperative intraocular pressure (IOP) over the follow-up period. At the fifth year of follow-up, the average IOP was 15.70 mmHg in the trabeculectomy group and 14.75 mmHg in the phacotrabeculectomy group. Survival analysis was performed using the Kaplan-Meier curve (Figure 2) to assess the success distribution between the trabeculectomy and phacotrabeculectomy groups. The log-rank

test yielded a p-value of 0.102, indicating no significant difference in the success rates between the two groups. The five-year cumulative survival rate was 58.6% for the trabeculectomy group and 85.4% for the phacotrabeculectomy group.

Discussion

This study found that the number of trabeculectomy procedures was much higher

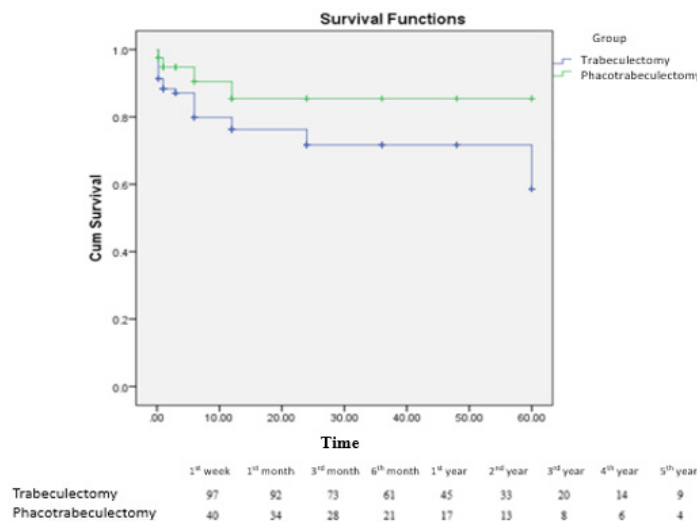


Figure 2 Survival Rates of Trabeculectomy and Phacotrabeculectomy

than that of phacotrabeculectomy. This can be explained based on the findings of intraocular pressure and cup-disc ratio between the two procedure groups, which were statistically different ($p < 0.05$). There was a higher mean IOP in the trabeculectomy group compared to IOP in the phacotrabeculectomy eyes. The high preoperative intraocular pressure was one of the factors that resulted in the change of chosen surgery from phacotrabeculectomy to trabeculectomy alone. The higher mean cup-disc ratio aligned with the larger mean IOP in the trabeculectomy group. This condition provides information that patients who come for treatment at our hospital have advanced glaucoma stage.

Although the majority of the patients had cataracts, trabeculectomy alone without lens extraction remained the most preferred option due to the large number of patients presenting with severe glaucoma with high IOP. The choice of trabeculectomy alone is expected to reduce the risk of more significant postoperative inflammation, which may affect the results of blebs that are formed and will ultimately affect the final IOP outcome.⁶⁻⁸

Some literature suggests that phacotrabeculectomy carries a higher risk of complications compared to trabeculectomy. This is consistent with the findings in this study, which reported complications in 7.2% of the phacotrabeculectomy group.^{4,5,9} These complications were choroidal detachment, malignant glaucoma, and vitreous prolapse that occurred in 3 different patients. Patients with choroidal detachment received treatment in the form of oral steroids for one week. The patient's visual acuity decreased from 0.2 to 0.05 after choroidal detachment resolved. No complication occurred in the trabeculectomy group. This differs from previous studies that reported trabeculectomy is more frequently complicated by hyphema, as noted by Song et al. and Mei et al.^{4,5} In contrast, this study found no hyphema complications in either treatment group. Mei et al. also found a 12% incidence of elevated intraocular pressure (IOP) on the first postoperative day in the phacotrabeculectomy group, but no IOP spike was observed in this study.

In this study, one eye had malignant glaucoma in the second week of follow-up after phacotrabeculectomy surgery. The patient underwent vitrectomy and anterior chamber reformation. The patient's visual acuity decreased from 0.1 to light perception. The

complications of malignant glaucoma in this study are similar to the findings of Varma et al.,¹⁰ who found malignant glaucoma in the 1-3 weeks follow-up period after cataract surgery. In their study, Krix-Jachym et al. found an incidence of 1.81% in postphacotrabeculectomy patients.¹⁰⁻¹²

The success rate of the two groups was analyzed using survival analysis. Based on the statistical test results, there was no difference between the two treatment groups ($p = 0.102$), with the cumulative survival rate of the trabeculectomy group at 58.6% and phacotrabeculectomy at 85.4% in the fifth year. In various studies, Rotchford et al. found that the success rate of trabeculectomy and phacotrabeculectomy varied between 36% and 98%. Lazcano-Gomez et al.,⁶ found similar things when conducting a study on the Hispanic population. There was no statistically significant difference between the success rates of the two groups. Likewise, Choy et al.¹² also found that the results of phacotrabeculectomy were comparable to trabeculectomy.¹³

Several possibilities that underlie the comparable success between the two treatment groups in this study are the age difference between the two treatment groups, intraocular pressure before the procedure, and postoperative anti-inflammatory administration. Various literatures said that older age results in lower postoperative inflammation. The lower baseline intraocular pressure in the phacotrabeculectomy group could also make the IOP reduction results comparable between the two groups. Some literature suggests that although there is greater inflammation in phacotrabeculectomy, the larger anterior chamber angle opening due to the extracted lens allows better aqueous outflow so that trabeculectomy and phacotrabeculectomy can have comparable effectiveness in controlling intraocular pressure. However, in this study, postoperative anterior chamber angle examination was not analyzed, so the effect of phacotrabeculectomy on anterior chamber angle changes could not be seen.^{6,12,13}

Postoperative anti-inflammatory treatment was administered to both treatment groups. Patients received topical prednisolone acetate, initially given every four hours per day, with a gradual decrease in dosage each week. This treatment aimed to modulate the inflammatory response in both groups, thereby reducing the risk of bleb failure and helping achieve intraocular pressure (IOP) reduction. However, inflammation status could not be analyzed in this study due to limited data in the medical records.

Additionally, the condition of the bleb formed after surgery could not be evaluated during the follow-up period, as bleb morphology data were not available in the medical record. Amatlouh et al.¹⁴ in their meta-analysis of steroid use after trabeculectomy and phacotrabeculectomy, found that topical steroid administration was more effective in controlling IOP compared to placebo, likely due to its action during the inflammatory phase of wound healing.¹⁵

This study, as a retrospective analysis, has several limitations. First, randomization of patients was not performed, and the indications for selecting the type of surgery may have differed between the two groups. Trabeculectomy is typically indicated for patients with uncontrolled intraocular pressure, whereas phacotrabeculectomy is performed in patients with cataracts that significantly impair vision, but with intraocular pressure better controlled through antiglaucoma medications. Second, the trabeculectomy group was significantly outnumbered by the phacotrabeculectomy group, which could introduce bias. Third, due to the retrospective nature of the study, we were unable to adjust for potential confounders, such as inflammatory conditions.

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