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Original Article

Trabeculectomy Surgery in Primary and Secondary Glaucoma: Retrospective Cross-sectional Analysis

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ABSTRACT

Background: Glaucoma remains a leading cause of permanent blindness worldwide, with elevated intraocular pressure (IOP) as the most modifiable risk factor. When medical therapy fails, trabeculectomy is often the preferred surgical option, though its effectiveness may differ based on the type of glaucoma. Primary glaucoma is typically idiopathic, while secondary glaucoma results from identifiable causes such as trauma, inflammation, or diabetes. Understanding these distinctions is essential for optimizing surgical outcomes and tailoring patient-specific treatment strategies. This study aims to determine whether there is a difference between the reduction in intraocular pressure in primary and secondary glaucoma after undergoing trabeculectomy surgery.

Methods: This descriptive cross-sectional study used purposive sampling to select medical records of patients who underwent trabeculectomy at the Christian University of Indonesia Teaching Hospital from July 2021 to June 2022. A total of 30 patients were included. Inclusion criteria were patients diagnosed with either primary or secondary glaucoma who underwent trabeculectomy and had complete pre- and postoperative IOP data. Exclusion criteria included patients with previous glaucoma surgery, incomplete medical records, or less than one month of follow-up. The primary outcome was the percentage reduction in IOP one month postoperatively..

Results: The results showed that the percentage reduction in IOP within 1 month in primary glaucoma was 43.54%, whereas in secondary glaucoma, it was 41.87%. P value > 0.05 in all postoperative IOPs between primary glaucoma and secondary glaucoma.

Conclusion: Trabeculectomy is still the first choice to reduce IOP, which has failed pharmacological treatments. However, there was no significant difference between decreased intraocular pressure in patients with primary and secondary glaucoma.

Keywords: Primary Glaucoma, Secondary Glaucoma, Intraocular Pressure, Trabeculectomy, Surgical Outcomes.

Implications for Practice:

- Tailored Surgical Planning: Understanding the type of glaucoma (primary vs. secondary) helps clinicians anticipate potential outcomes and plan more personalized surgical interventions.
- Equal Consideration for Trabeculectomy: Trabeculectomy remains effective in both glaucoma types, supporting its continued use regardless of etiology when pharmacological treatments fail.
- Postoperative Monitoring Focus: Although IOP reduction is comparable, secondary glaucoma may present with more variable responses, warranting closer postoperative follow-up

Introduction

As the second most common cause of irreversible blindness worldwide, glaucoma involves a slow, progressive Impairment of the optic nerve, commonly linked with elevated intraocular pressure (IOP)(Allison et al., 2020). The management of glaucoma aims to lower IOP and prevent further optic nerve damage, with surgical interventions playing a crucial role in cases where medical therapy is insufficient (Conlon et al., 2017). Among these surgical options, Trabeculectomy is still regarded as one of the most routinely executed procedures to reduce IOP (Kansal et al., 2020). Nevertheless, the effectiveness of trabeculectomy may fluctuate according to the glaucoma classification, whether primary or secondary. Primary glaucoma is often idiopathic and is typically associated with chronic elevation of IOP, while secondary glaucoma results from underlying conditions such as trauma, inflammation, or other ocular pathologies (*Perpustakaan Kemenkes "RS Mata Cicendo Portal Perpustakaan RSM Cicendo Road Map of Visual Impairment Control Program in Indonesia 2017 – 2030*," 2019). The response to trabeculectomy in these two groups may differ due to the distinct pathophysiological mechanisms involved.

Globally, glaucoma is recognized as a major contributor to permanent vision loss. The World Health Organization (WHO) estimates indicate that glaucoma impacts more than 70 million people, with approximately 10% of them experiencing bilateral blindness due to this disease. Therefore, IOP management is key to preventing further vision loss. Progressive damage to the optic nerve, primarily due to increased intraocular pressure (IOP), is a hallmark of glaucoma. Primary glaucoma occurs without a clear cause and includes "primary open-angle glaucoma" (POAG) and "primary angle-closure glaucoma" (PACG). Meanwhile, secondary glaucoma is the result of an identifiable ocular or systemic condition (Kanaya et al., 2021; Sambhara & Aref, 2014), such as trauma, uveitis, neovascularisation, or the use of certain medications such as corticosteroids. These etiological differences contribute to variations in disease course, response to therapy, and outcomes of surgical intervention.

Trabeculectomy represents the primary surgical intervention used in glaucoma treatment that does not respond to pharmacological therapy. This technique aims to create a new drainage channel that enables aqueous humour to exit the anterior chamber and enter the subconjunctival space, thereby decreasing intraocular pressure. (Kanaya et al., 2021; Pantalon et al., 2021). Although this technique has been used for over half a century and has proven effective, its effectiveness and long-term outcomes are greatly influenced by various factors, including the type of glaucoma. In clinical practice, patients with primary and secondary glaucoma show different characteristics, including age at diagnosis, comorbidities, severity of initial intraocular pressure, and postoperative complications. Therefore, it is important to evaluate whether the effectiveness of trabeculectomy in lowering IOP is similar in these two groups. This understanding will impact patient selection and treatment planning and may help develop more personalized clinical guidelines.

This study compares the effectiveness of intraocular pressure reduction following trabeculectomy between patients with primary glaucoma and secondary glaucoma at the Universitas Kristen Indonesia Teaching Hospital in Jakarta. By exploring the differences in surgical outcomes, this research could provide valuable insights for clinicians to optimize treatment strategies and improve the quality of life for glaucoma

patients. The findings may also contribute to refining surgical approaches tailored to specific glaucoma types, enhancing patient care and long-term outcomes.

Methods

Study Design

This research employed a descriptive cross-sectional design using secondary data from medical records. The study was conducted at the Christian University of Indonesia Teaching Hospital over 12 months from July 2021 to June 2022

Participants

Participants in this study were all patients undergoing trabeculectomy who met the inclusion and exclusion criteria. The inclusion criteria were 1) patients with primary and secondary glaucoma who had undergone trabeculectomy, and 2) who had had routine check-ups for 3 months. IOP examinations were performed twice for each measurement using the same device to eliminate bias, with a 5-minute interval between examinations. Trabeculectomy was performed on these patients by a single Ophthalmologist to ensure uniformity in treatment for all patients undergoing trabeculectomy.

Instruments

Intraocular pressure (IOP) was measured using Goldmann Applanation Tonometry (GAT), considered the gold standard for IOP measurement. Measurements were taken by trained ophthalmic personnel. While the validity and reliability of GAT have been established in previous literature, no recalibration or internal reliability assessment was performed during this study period.

Data Collection

The collected data included patient demographic information, initial IOP when visiting the clinic, IOP at 1 week, 1 month, and 3 months post-surgery, and the number of medications used by patients before and 3 months after surgery. In this study, patients who underwent trabeculectomy were those whose IOP could not be adequately controlled with medication.

Data Analysis

The data were then statistically analyzed using the Friedman correlation, Kruskal-Wallis, and McNemar tests. The statistical test results were considered significant or correlated based on a p-value <0.05. All analyses were performed using the SPSS statistical program

Ethical Considerations

This study was conducted using secondary data from patient medical records and received approval from the Ethics Committee of Universitas Kristen Indonesia. All patient data were anonymized to ensure confidentiality, and no identifiable personal information was used. The research adhered to the principles of the Declaration of Helsinki.

Results

From **Table 1,** it can be observed that the frequency of glaucoma patients, both primary and secondary, is highest in the age group of 56-65 years, with a percentage of 43.3% or 13 individuals, and the lowest in the age groups of <36 years and 36-45 years, each with a rate of 6.7% or two individuals. Additionally, the table also shows that the majority of glaucoma sufferers are female, with a percentage of 63.3% or 19 individuals, followed by males with a rate of 36.7% or 11 individuals. It was also found that the number of secondary glaucoma cases due to lens changes was six individuals, due to uveitis was four individuals, due to trauma was one individual, and due to unspecified causes was one individual.

The average IOP from preoperative to 1 month postoperative. The average preoperative IOP for primary glaucoma was 29.52 mmHg with a standard deviation of 12.34, while the average preoperative IOP for secondary glaucoma was 44.54 mmHg with a standard deviation of 13.51. The average IOP 1 month postoperatively for primary glaucoma was 16.67 mmHg with a standard deviation of 8.67. In contrast, the average IOP 1 month postoperatively for secondary glaucoma was 25.89 mmHg with a standard deviation of 16.82. By comparing the average preoperative IOP and the 1-month postoperative IOP, the percentage reduction in IOP over 1 month was found to be 43.54% for primary glaucoma and 41.87% for secondary glaucoma.

Table 1. Patient Characteristics by Age and Gender, Mean Preoperative IOP (mmHg), Mean Postoperative IOP (mmHg)

Variables	Primary Glaucoma (n = 18)	Secondary Glaucoma (n = 12)	Total (n = 30)
Age, years			
< 36	1 (5.6%)	1 (8.3%)	2 (6.7%)
36–45	0 (0.0%)	2 (16.7%)	2 (6.7%)
46–55	2 (11.1%)	2 (16.7%)	4 (13.3%)
56–65	9 (50.0%)	4 (33.3%)	13 (43.3%)
> 65	6 (33.3%)	3 (25.0%)	9 (30.0%)
Mean ± SD	61.39 ± 12.40	55.92 ± 13.92	59.20 ± 13.08
Gender			
Male	7 (38.9%)	4 (33.3%)	11 (36.7%)
Female	11 (61.1%)	8 (66.7%)	19 (63.3%)
Type of Secondary Glaucoma	—		
• Lens-induced	—	6 (50.0%)	6 (20.0%)
• Uveitis	—	4 (33.3%)	4 (13.3%)
• Trauma	—	1 (8.3%)	1 (3.3%)
• Unspecified	—	1 (8.3%)	1 (3.3%)
Intraocular Pressure (mmHg)			
Preoperative	29.52 ± 12.34	44.54 ± 13.51	35.53 ± 14.65
Postoperative Week 1	24.15 ± 13.58	26.57 ± 18.07	25.12 ± 15.28
Postoperative Month 1	21.41 ± 14.01	27.67 ± 16.92	23.91 ± 15.28
Postoperative Month 3	16.67 ± 8.67	25.89 ± 16.82	20.36 ± 13.13
IOP Reduction in 3 Months (%)	43.54%	41.87%	42.69%

Abbreviations:
IOP = Intraocular Pressure;
SD = Standard Deviation;
n = Number of Patients (Eyes);
mmHg = Millimetres of Mercury.

Figure 1 shows the average IOP from preoperative to 3 months postoperative. The average preoperative IOP for primary glaucoma was 29.52 ± 12.34 mmHg, while the average preoperative IOP for secondary glaucoma was 44.54 ± 13.51 mmHg. The average IOP 3 months postoperatively for primary glaucoma was 16.67 ± 8.67 mmHg, whereas the average IOP 3 months postoperatively for secondary glaucoma was 25.89 ± 16.82 mmHg. By comparing the two average IOP values preoperatively and 3 months postoperatively, the percentage of IOP reduction in 3 months in primary glaucoma was 43.54%, and in secondary glaucoma it was 41.87%.

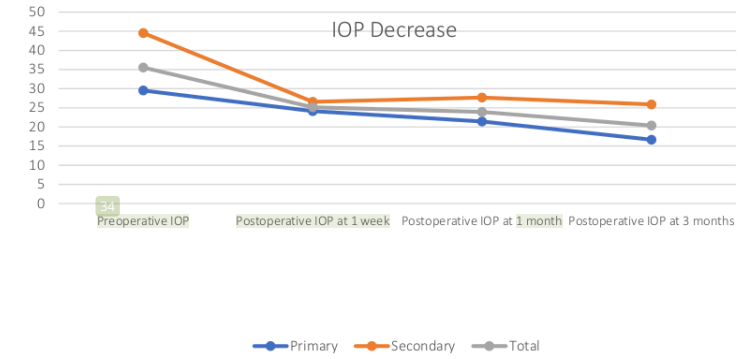

Figure 1. Graph of IOP Reduction in Primary Glaucoma and Secondary Glaucoma

Based on the results of the Friedman test in **Table 2**, a P value <0.05 was obtained, so it can be concluded that there is a significant difference between the IOP values before and after trabeculectomy. The Kruskal-Wallis test findings indicate that all postoperative IOP values had a P-value > 0.05 between primary and secondary glaucoma. Consequently, the reduction in intraocular pressure is not significantly different between patients with primary and secondary glaucoma. The medications used before and after trabeculectomy in primary and secondary glaucoma patients. Before trabeculectomy, the average number of medications used was 1.83 ± 0.592 drugs. On the other hand, the number of medicines after trabeculectomy was 0.9 ± 0.548 drugs. A Wilcoxon analysis yielded a P-value < 0.05, indicating a statistically significant medication reduction.

Table 2. Comparison of Preoperative IOP, 1 Week Postoperative IOP, 1 Month Postoperative IOP, and 3 Months Postoperative IOP Values

Variable	Primary Glaucoma	Secondary Glaucoma	P-value (Within Group)	P-value (Between Groups)
IOP (mmHg)				
Preoperative IOP	29.52 ± 12.34	44.54 ± 13.51	0.003 †	0.06
Postoperative IOP – Week 1	24.15 ± 13.58	26.57 ± 18.07	—	0.783
Postoperative IOP – Month 1	21.41 ± 14.01	27.67 ± 16.92	—	0.299
Postoperative IOP – Month 3	16.67 ± 8.67	25.89 ± 16.82	—	0.102
Number of Medications (Mean ± SD)				
Before Trabeculectomy	1.67 ± 0.59	2.08 ± 0.52	—	—
After Trabeculectomy	0.78 ± 0.43	1.08 ± 0.67	*P < 0.05* ‡	—

Abbreviations:
IOP = Intraocular Pressure;
SD = Standard Deviation;
mmHg = Millimetres of Mercury;
† = Friedman test (within-group comparison);
‡ = Wilcoxon signed-rank test (medication reduction).

Discussion

In the demographic data of glaucoma patients, females dominate, and the majority are aged 56-65 years. This aligns with research by Reinne et al. at the Christian University of Indonesia Hospital, which also found that the majority of glaucoma patients were in the 56-65 age group. Research by Kono *et al*. in Japan found that primary and secondary glaucoma were most prevalent in patients aged approximately 62.4 years and 60.4 years, respectively. Similarly, research by Dizayang *et al*. at Muhammadiyah Hospital in Palembang identified the 40-64 age group as having the highest number of glaucoma patients. (Christine et al., 2021; Dizayang et al., 2020; Kono et al., 2020). Additionally, research by Putri et al. found that the majority of primary glaucoma patients were in the 51-80 age group, consistent with a study at RSCM Surabaya, which reported that the average age of primary glaucoma patients at RSCM was 60.74 years, with the most significant proportion in the 55-64 age group. (Kyei et al., 2021)This is likely because the eye lens thickens in this age range, narrowing the anterior chamber angle and obstructing the flow of aqueous humour. (Nugraha et al., 2019)

The comparison of IOP before surgery and at multiple postoperative intervals (1 week, 1 month, and 3 months) via the Friedman test in bivariate analysis yielded a P-value < 0.05, demonstrating a meaningful difference attributable to trabeculectomy (Fea et al., 2012). This result is in agreement with the research by Maeda et al., who observed a significant variation in IOP values before and after surgery, covering postoperative points at day 1, week 1, and month 1 (Maeda et al., 2013). Shoji et al. also found differences in preoperative and postoperative IOP values, including at 1 day, 1 week, and 1 month after surgery. (Shinohara et al., 2017). Similarly, the study by Shinohara et al. showed a significant reduction in IOP starting from preoperative values through 1 day, 3 days, 1 week, 2 weeks, 1 month, 3 months, and 6 months postoperatively in secondary glaucoma, particularly in neovascular glaucoma.[13]

In this study, the difference in preoperative and postoperative IOP can be seen more clearly when comparing the preoperative intraocular pressure value with the intraocular pressure value 3 months after surgery, as seen in Table 2. The average preoperative IOP for both types of glaucoma was 35.53 mmHg, while the average 3-month postoperative IOP for both types was 20.36 mmHg, with a reduction percentage of 42.69%. This indicates that the trabeculectomy procedure performed was successful in reducing IOP. In a study conducted by Anca et al., the success rate of trabeculectomy in advanced primary and secondary open-angle glaucoma cases reached 77% and 88.6%, respectively (Pantalon et al., 2021). This differs from the study by Nabila et al., where the success rate of trabeculectomy in secondary glaucoma cases was only 15.8% after 1 month and 42.1% after 3 months. The failure rate of trabeculectomy was 73.7% after 1 month and 47.4% after 3 months (Maulida et al., 2021). In a study by Kanaya et al., it was noted that trabeculectomy performed in uveitic glaucoma cases had similar success and IOP control rates as in primary open-angle glaucoma (POAG) cases (Kanaya et al., 2021). Another study by Sirisha et al., which compared phacoemulsification with phaco-trabeculectomy in lens-induced glaucoma cases, found no difference in IOP at the 6-month follow-up. However, phacoemulsification surgery was faster and improved visual quality more effectively (Senthil et al., 2016).

Relevance to Clinical Practice

This study highlights that trabeculectomy is equally effective in reducing intraocular pressure in both primary and secondary glaucoma,

supporting its continued use as a surgical option when medical therapy fails. Recognizing that the IOP reduction does not significantly differ between the two types allows clinicians to make more confident decisions in selecting trabeculectomy regardless of glaucoma etiology. These findings can guide ophthalmologists in delivering evidence-based, equitable surgical care and emphasize the importance of consistent postoperative monitoring to ensure optimal outcomes.

Conclusion

Our study comparing the reduction in IOP after trabeculectomy in primary and secondary glaucoma groups found a significant difference between intraocular pressure values before and after the trabeculectomy procedure. No significant variation in the decrease of intraocular pressure was identified between primary glaucoma and secondary glaucoma patients in this study. To date, the trabeculectomy procedure remains a preferred option for patients with both primary and secondary glaucoma. Future research could include more data, such as patients undergoing phaco-trabeculectomy or other combined procedures.

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CrediT Authorship Contributions Statement

Reinne Natali Christine: Conceptualization, Methodology, Supervision, Writing – Original Draft
Nicolas Dwiki Tanong: Software, Validation, Formal Analysis, Writing – Review & Editing
Claudia: Investigation, Data Curation, Project Administration
Frisca Angreni: Writing – Review & Editing, Visualization

Conflicts Of Interest

The authors declare no conflict of interest.

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