

Trabeculectomy with Mitomycin C Treatment Outcomes in Secondary Glaucoma at Naresuan University Hospital

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Objective: To examine clinical outcomes following trabeculectomy with mitomycin C (MMC) in patients with secondary glaucoma.

Materials and Methods: The present study was a retrospective study of patients with secondary glaucoma that underwent an initial trabeculectomy with MMC at Naresuan University Hospital. The main outcome measure was postoperative intraocular pressure (IOP) at 24-month follow-up. Postoperative anti-glaucoma medication, success rate, and complications were secondary outcomes. Complete success was defined as IOP of 21 mmHg or less without any additional medication, whereas qualified success was defined as IOP of 21 mmHg or less with additional medication.

Results: The present study included 72 eyes from 68 patients. The preoperative IOP was 33.8±5.75 mmHg (mean ± standard deviation) under 3.61±0.57 anti-glaucoma medications. At 24 months, the mean postoperative IOP was 18.36±3.6 mmHg under 1.65±1.7 anti-glaucoma medications. The complete and overall success rates were 44.4% and 86.1%, respectively. Nine eyes (12.5%) developed postoperative hyphema. The eyes without hyphema were significantly better than those with hyphema ($p<0.001$), as determined by the Kaplan-Meier survival analysis with the log-rank test.

Conclusion: Trabeculectomy with MMC decreased IOP and the number of antiglaucoma drugs prescribed to patients with secondary glaucoma over a 24-month period. The most prevalent postoperative complication was hyphema, which was associated with postoperative failure.

Keywords: Secondary glaucoma; Trabeculectomy with MMC; Intraocular pressure (IOP); Complications

Received 22 September 2021 | Revised 18 May 2022 | Accepted 20 May 2022

J Med Assoc Thai 2022; 105(8):724-8

Website: <http://www.jmatonline.com>

Secondary glaucoma is a common type of glaucoma in which the cause of increased intraocular pressure (IOP) can be identified, resulting in optic nerve injury and vision loss. Secondary glaucoma cause significantly more ocular morbidity and visual impairment than primary glaucoma, despite representing a smaller proportion of the disease. Most patients with secondary glaucoma have poor vision with high IOP and advanced fundus changes at presentation^(1,2). Early detection of underlying ocular and systemic disorders that lead to secondary glaucoma may go a big step further reducing the burden of avoidable blindness⁽³⁾. The cause of elevated eye pressure could be a localized problem in the eye,

a general condition, or the use of medicine. It can be treated both by managing the underlying condition and by taking hypotensive medication or having surgery to lower the IOP⁽⁴⁾.

The trabeculectomy is used when a more significant reduction of IOP is needed to control glaucoma. This procedure involves creating an opening in the limbus to improve aqueous humor outflow and decrease IOP. The failure of the surgery is associated with inflammation, new blood vessel formation and scarring that can cause closure of the opening and subconjunctival space. The primary trabeculectomy without adjunctive mitomycin C (MMC) shows that, despite successful control of IOP after one year, the rate of success falls over time, stabilizing at 67 % by 10 years^(5,6). Chen reported in 1983 that MMC enhanced the IOP-lowering efficacy of trabeculectomy when applied intraoperatively to eyes with a high risk of surgical failure, and that MMC caused almost complete inhibition of fibroblast proliferation on human Tenon's capsule⁽⁷⁾. The intraoperative use of MMC has increased the long-term success rate of trabeculectomy in patients with glaucoma, but there are limited studies regarding its outcomes in secondary glaucoma.

The purpose of the present retrospective study

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How to cite this article:

Phruancharoen C. Trabeculectomy with Mitomycin C Treatment Outcomes in Secondary Glaucoma at Naresuan University Hospital. *J Med Assoc Thai* 2022;105:724-8.

DOI: 10.35755/jmedassochai.2022.07.13348

was to evaluate the outcome of initial trabeculectomy with MMC in the treatment of secondary glaucoma over a 24-month period.

Materials and Methods

The present study retrospectively analyzed the medical records of patients diagnosed with secondary glaucoma. The subjects were investigated using ICD 10 codes. The inclusion criteria included 1) patients with secondary glaucoma who underwent initial trabeculectomy with MMC by a single glaucoma specialist using the same technique between January 2011 and July 2018 at the Department of Ophthalmology, Naresuan University Hospital, 2) patients with no history of previous glaucoma surgery, and 3) patients who completed a comprehensive ophthalmic examination including a best corrected visual acuity (BCVA) test, slit lamp examination, gonioscopy, Goldmann applanation tonometry, funduscopy, and 24-2 Humphrey visual fields. The study excluded 1) patients with a follow-up period of less than 24 months, and 2) patients with inadequate medical records. Secondary glaucoma refers to any form of glaucoma in which there is an identifiable cause of increased IOP to more than 21 mmHg, with glaucomatous optic nerve damage and visual field loss. Age, gender, etiology of secondary glaucoma, number of antiglaucoma medications, and IOP were recorded. The present retrospective study was approved by the Institutional Review Board of Naresuan University, Phitsanulok, Thailand (IRB No. P3-0128/2564).

The main outcome measure was IOP reduction at 24 months postoperatively. Secondary outcome measures included the rate of surgical success at 24 months, the number of postoperative antiglaucoma medications, and the postoperative complications. Complete success was defined as postoperative IOP reading of 21 mmHg or less without any additional medication, whereas qualified success was defined as postoperative IOP of 21 mmHg or less with additional medication. Failure was defined as an IOP of more than 21 mmHg with anti-glaucoma medication or below 6 mmHg on two consecutive study visits. Failure was also defined as the loss of light perception or the need for further glaucoma surgical intervention.

The Stata, version 12.0 (StataCorp LP, College Station, TX, USA) was utilized to conduct statistical analyses. The descriptive statistics of the data included mean standard deviation (SD) and percentages, as applicable. Comparison of numerical variables were accomplished using repeated measures ANOVA.

Surgical success was assessed by Kaplan-Meier survival analysis, with the p-value derived from a log-rank test. A p-value of less than 0.05 was considered significant.

Trabeculectomy with MMC was performed on all cases by a single glaucoma specialist using the same technique. In the present study, a fornix-based conjunctival flap was made, as an incision technique for trabeculectomy, followed by a half-layer scleral flap. Small pieces of MMC-soaked sponge (0.4 mg/mL) were applied for two to three minutes to exposed tissues, including the tenon capsule and posterior surface of the conjunctiva, adjacent episcleral tissue, and scleral flap. After removing all sponges, 200 mL of a balanced salt solution was used to irrigate the wounds. A trabecular block was excised by scleral punch, and peripheral iridectomy was then performed. The scleral flap and conjunctiva were secured with 10-0 nylon monofilament sutures. All patients with neovascular glaucoma (NVG) were given intravitreal anti-VEGF injections one to two weeks prior to trabeculectomy. Postoperatively, all patients received the topical regimen consisting of 1% prednisolone acetate ophthalmic suspension and 0.5% moxifloxacin HCl ophthalmic solution for six to 12 weeks. Depending on the IOP and bleb formation, laser suture lysis was administered as required.

Results

Seventy-two eyes from 68 patients that completed a 24-month follow-up were included in the present study. There were 38 male patients (55.9 %) and 30 female patients (44.1%). Mean age was 56.8±13.6 years. The patient demographics are shown in Table 1. The mean preoperative and postoperative IOP was 33.82±5.73 mmHg and 18.3±3.69 mmHg, respectively ($p<0.001$). The 45.7% IOP reduction was achieved at 24 months ($p<0.001$). Mean number of glaucoma medication dropped from 3.61±0.57 preoperatively to 1.65±1.70 at 24 months follow-up ($p<0.001$) (Table 2). At the 12-month and 24-month follow-ups, 10 and 30 eyes, respectively, required glaucoma medication.

The present study demonstrated an overall success rate of 86.1% with 44.4% (32 eyes) that achieved complete success, and 41.7% (30 eyes) that achieved qualified success at the 24-month follow-up, whereas 13.9% (10 eyes) met the failure criteria. The cumulative Kaplan-Meier survival probability of all eyes are shown in Figure 1. Other than laser suture lysis, no additional glaucoma surgery or laser was necessary for IOP reduction in the success group.

Table 1. Patient demographics (total 68 patients)

Demographics	n (%)
Number of eyes	72
Sex	
Male	38 (55.9)
Female	30 (44.1)
Age (years); mean±SD	56.8±13.6
Best corrected visual acuity	
20/200 or better	51 (70.8)
Counting fingers	10 (13.9)
Hand motion	8 (11.1)
Light perception	3 (4.2)
Etiology of secondary glaucoma	
Neovascular glaucoma	33 (45.8)
Uveitis	17 (23.6)
Post-vitreotomy	10 (13.8)
Trauma	5 (6.9)
Pseudoexfoliation	4 (5.5)
Steroid	2 (2.7)
Post-keratoplasty	1 (1.3)

SD=standard deviation

Nine eyes (12.5%) with NVG experienced hyphema, which resolved within one to seven days. The Kaplan-Meier survival curve for eyes with and without hyphema revealed the group without hyphema had a significantly higher success rate ($p<0.001$) than the group with hyphema (Figure 2). One eye (1.3%) developed hypotony at IOP of less than 6 mmHg without maculopathy, which subsided after one week without further intervention. Two eyes (2.7%) exhibited hypotony with choroidal detachment two days after the surgery, which resolved following bleb revision. One case of choroidal detachment was found in the 72-year-old male with post-vitreotomy, and another case was found in the 68-year-old female with uveitic glaucoma (Table 3).

Discussion

For more than 50 years, trabeculectomy continues to be the gold standard surgical procedure for glaucoma⁽⁸⁾. It has been characterized as a procedure that has a low rate of success for eyes with secondary glaucoma due to intraoperative complications and

Table 2. Baseline and postoperative data

	Baseline; mean±SD	Postoperative 24-month; mean±SD	Difference (95% CI)	p-value
Intraocular pressure (mmHg)	33.82±5.73	18.36±3.69	15.46 (14.03 to 16.89)	<0.001
Number of medications	3.61±0.57	1.65±1.70	1.96 (1.57 to 2.35)	<0.001

SD=standard deviation; CI=confidence interval

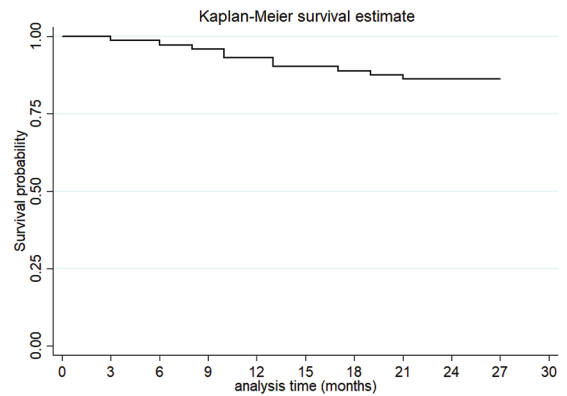


Figure 1. Kaplan-Meier survival curve of all eyes.

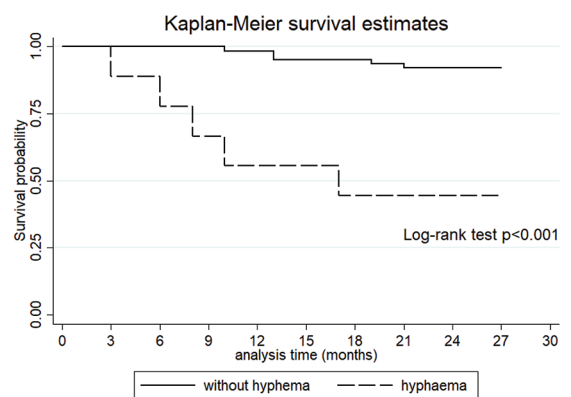


Figure 2. Kaplan-Meier survival curve for the group with hyphema and the group without hyphema.

postoperative progression of episcleral fibrosis at the aqueous humor outflow site⁽⁹⁾. However, antifibrotic agent-assisted trabeculectomy was a well-established surgical technique for improving surgical outcomes. Data suggested that adjunctive surgery with MMC improved the prognosis for trabeculectomy function^(10,11).

The present retrospective study showed that trabeculectomy with MMC effectively decreased IOP and glaucoma medications at 24 months in patients with secondary glaucoma as compared to the baseline. The present study demonstrated a reduction in mean IOP from 33.82±5.73 mmHg preoperatively to 18.3±3.69 mmHg at 24 months.

Table 3. Postoperative complications (72 eyes)

Complications	n (%)
Hyphema	9 (12.5)
Wound leakage	3 (4.1)
Choroidal detachments	2 (2.7)
Hypotony without maculopathy	1 (1.3)

The mean number of glaucoma medications reduced from 3.61 ± 0.57 preoperatively to 1.65 ± 1.70 at 24 months, with 41.66% of patients requiring glaucoma medications again at 24 months (Table 2). Each study had a different definition of clinical success, making it difficult to directly compare the results. In the present study, complete and overall success rates were 44.4%, and 86.1%, respectively, at a 24-month follow-up for secondary glaucoma patients meeting the aforementioned criteria. Previous studies reported that the success rate ranged from 77.8% to 95% based on various success parameters⁽¹²⁻¹⁷⁾. Differences in study duration, patient demographics, surgical techniques, the etiology of secondary glaucoma, and sample size also influenced the success rates.

In the present study, hyphema was the most common postoperative complication in NVG. The Kaplan-Meier survival analysis with log-rank test indicated a significantly higher success rate in the group without hyphema compared to the group with hyphema ($p < 0.001$). It was hypothesized that a postoperative hyphema was associated with trabeculectomy failure. Similarly, previous studies concluded that hyphema was a risk factor for trabeculectomy failure in NVG^(18,19). Nakatake et al demonstrated that a sufficiently long interval between intravitreal anti-VEGF injections and trabeculectomy could prevent postoperative hyphema following trabeculectomy⁽²⁰⁾.

The major limitation of the present study was the lack of randomization due to its retrospective design. Due to the complexity of the technique and because a single surgeon undertook the present study, there might have been an effect of the learning curve. Nonetheless, the same ophthalmologist followed up with all patients and collected data on a regular basis. The present study might have lacked statistical power for subgroup analyses of success and failure due to its small sample size. A prospective study with large sample size and long-term follow-up of the study subjects is necessary in the future.

Conclusion

In patients with secondary glaucoma,

trabeculectomy with MMC was effective in reducing IOP up to 24 months after surgery. The most prevalent postoperative complication in NVG was hyphema, which was correlated with surgical failure.

What is already known on this topic?

Secondary glaucoma is a common type of glaucoma, and trabeculectomy with MMC is the most common glaucoma surgery. The outcome of trabeculectomy in secondary glaucoma has been different. Different outcomes have been observed following trabeculectomy for secondary glaucoma. The disparity in the results may be attributable to distinct surgical techniques and evaluation criteria.

What this study adds?

This study reported the positive outcome of trabeculectomy with MMC for the treatment of secondary glaucoma.

Conflicts of interest

The authors declare no conflict of interest.

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