Effectiveness of Phacoemulsification with Goniosynechialysis in Angle Closure

Dechathon Asanathong, M.D.

Department of Ophthalmology, Sisaket Hospital, Sisaket 33000, Thailand

Abstract

Objective: To study the effect of phacoemulsification with goniosynechialysis on the reduction of intraocular pressure and the medications usage in the treatment of patients with angle closure glaucoma.

Materials and Methods: Patients who underwent phacoemulsification with goniosynechialysis between January 2019 and January 2022 were included in the study. Patient histories and records were obtained from the electronic hospital database.

Results: A total of 28 patients were included in this study, 75% being female, were enrolled in the study. The distribution of left and right eyes was equal. The average age of the patients was 59.28 ± 8.04 years, and the mean visual acuity was Logmar 0.92 ± 0.46. The average intraocular pressure (IOP) at baseline was 25.07 ± 12.66 mmHg, ranging from 9 to 55 mmHg. The patients were using an average of 2.86 ± 1.33 types of glaucoma medications. After 3 months of treatment, the average number of drops of glaucoma medications used decreased from 3.93 to 1.64 drops (P = <0.001, 95%CI [1.35, 3.22]). The average intraocular pressure decreased from 25.07 mmHg to 12.75 mmHg (P = <0.001, 95%CI [7.76, 16.88]), and the average number of types of glaucoma medications decreased from 2.86 to 1.53 (P = <0.001, 95%CI [0.65, 2.00]).

Conclusions: Phacoemulsification with goniosynechialysis has been shown to be effective in lowering intraocular pressure in patients with angle closure glaucoma. Additionally, this procedure has the potential to decrease the number and types of glaucoma medications needed for managing the condition.

Keywords: Angle Closure, Glaucoma, Phacoemulsification, Goniosynechialysis, Intraocular Pressure

EyeSEA 2024;19(1):38-46

Introduction

Glaucoma is the second leading cause of permanent vision loss from eye diseases worldwide,[1] with primary angle-closure glaucoma (PACG) being the most common in Asians, with a prevalence as high as 1.2%.[2] In Thailand prevalence was 0.9%[18] and a rate of angle closure of 5.3%.[3] Angle closure in PACG refers to the contact or adherence of the iris and trabecular meshwork (TM),[4] which is often found in individuals with small eyes and narrow angles, leading to increased intraocular pressure and resulting in angle-closure glaucoma.

Pupillary block is an important mechanism that can cause angle-closure glaucoma.[5] Laser iridotomy, which involves making a small hole in the iris, can be effective in preventing this condition.[6,7] However, it does not reduce intraocular pressure in patients who already have angle-closure glaucoma (PACG)[8] because other mechanisms cause this condition, such as narrow angles, large lens size, and plateau iris syndrome. In cases where the intraocular pressure is not adequately controlled with medications, surgical options such as trabeculectomy may be considered. However, this procedure may increase the risk of cataracts in the future.[9] Phacotrabeculectomy, which involves combining cataract surgery with trabeculectomy, may be considered in patients with concomitant

Correspondence to:
Dechathon Asanathong, M.D., *Department of Ophthalmology, Sisaket Hospital, Sisaket 33000, Thailand,*
E-mail: dr.deacha@gmail.com
Received : July 14th, 2023
Accepted : May 30th, 2024
Published : June 30th, 2024

cataracts, although it carries a higher risk of complications.[11,12] Phacoemulsification and goniosynechialysis are surgical procedures performed to remove peripheral anterior synechiae (PAS) at the angle of the eye, allowing aqueous humor to flow out through the trabecular meshwork more effectively and reducing intraocular pressure.[13-16] These procedures can be considered as an alternative to trabeculectomy.

Materials and Methods

This retrospective descriptive study was conducted in Sisaket Hospital, Thailand. We review medical records of patients who underwent phacoemulsification with goniosynechialysis with follow-up time of 3 months after surgery between January 2019 and January 2022. Post-operative diagnosis other than angle-closure, such as zonular dialysis, were excluded from our study. Baseline clinical characteristics included age, sex, visual acuity, intraocular pressure, which eye underwent the operation, cupping disc, diagnosis, history of glaucoma treatment, history of acute angle closure, The average number of types and drops of glaucoma drugs. The diagnosis was divided into three groups: primary angle closure glaucoma (PACG), acute angle closure (AAC), which is characterized by an acute rise in intraocular pressure (IOP) and pain, and refractory acute angle closure (RAAC), which is an AAC that is unresponsive to glaucoma medication or laser procedures.

The Patient had to follow up visits at the glaucoma clinic at one week, one month, and three months. Data was collected from an electrical database at a hospital. Visual acuity, intraocular pressure, and the average number of types and drops of glaucoma drugs were collected after surgery.

Surgical Procedure

Phacoemulsification with goniosynechialysis was performed using the standard phacoemulsification technique. After the intraocular lens was placed, OVDs (ophthalmic viscoelastic devices) were used to maintain the anterior chamber. Mori's lens was used to examine the ocular angle and a goniospatula was used to lyse the synechiae at the ocular angle for approximately 270 degrees from the main port. The OVDs were then removed and an anterior chamber was formed. If the anterior chamber could not be maintained, the main port was closed using sutures.

Statistical Aanalysis

Statistical analysis was performed using SPSS statistics software (SPSS, Inc., Chicago, IL, USA). Continuous variables are presented as mean ± standard deviation, while categorical variables are presented as frequency and percentage. Paired t-test were used to compare intraocular pressure and the average number of types and drops of glaucoma drugs before and after surgery. A p-value less than 0.05 was considered statistically significant.

Results

32 patients underwent phacoemulsification with goniosynechialysis and met the selection criteria, out of which 28 were enrolled in the study. The surgeries were performed on both left and right eyes, with a gender distribution of 75% female and 25% male (a ratio of 3:1). The mean age of the patients was 59.28 years. 21 patients had a history of acute angle closure glaucoma, accounting for 75% of the total.

Table 1: General information of patients who underwent phacoemulsification with goniosynechialysis

General information	Number (percentage)
Sex	
Male	7 (25.0)
Female	21 (75.0)
which eye underwent the operation	
Right	14 (50.0)
Left	14 (50.0)
Ages (Mean ± S.D.)	59.28 ± 8.04
Visual acuity (Mean ± S.D.)	Logmar 0.92 ± 0.46
IOP (Mean ± S.D.) Range of IOP	25.07 ± 12.66 9 - 55
Cupping of the optic disc	
0.3 - 0.5	11 (39.3)
0.6 - 0.7	6 (21.4)
>0.8	11 (39.3)
Diagnosis	
PACG	11 (39.3)
AAC	6 (21.4)
Retractory AAC (RAAC)	11 (39.3)
History of previous treatment for glaucoma	21 (75.0)
Laser peripheral iridotomy	18 (64.3)
Laser Iridoplasty	7 (25.0)
Trabeculectomy	1 (3.6)
History of acute angle closure	21 (75.0)
Number of types of glaucoma medication (Mean ± S.D.)	2.86 ± 1.33
Oral glaucoma medication	14 (50.0)
Number of drops of glaucoma medication (Mean ± S.D.)	3.93 ± 2.18

The treatment results showed that the patients had improved visual acuity from Logmar 0.92 to Logmar 0.4 (p-value<0.001, 95%CI [0.35, 0.68]) on average at the 3rd month of treatment (from VA 20/166 to VA 20/50). The average intraocular pressure decreased from 25.07 mmHg to 12.75 mmHg at the 3rd month of treatment (p-value <0.001, 95%CI [7.76, 16.88]). The average number of types of glaucoma medications decreased from 2.86 to 1.53 (p-value <0.001, 95%CI [0.65, 2.00]) and the average number of drops of glaucoma medications decreased from 3.93 to 1.64 at the 3rd month of treatment (p-value<0.001, 95%CI [1.35, 3.22]). The patients were able to stop taking all types of oral glaucoma medications. Complications during surgery included excessive bleeding in the anterior chamber of the eye in one case, Rupture lens capsule in one case, and plasmoid reaction in four cases.

Table 2: shows the results of treatment with phacoemulsification with goniosynechialysis.

	Pre-operative	1st week	1st month	3rd month
Visual acuity Logmar (Mean ± S.D.)	0.92 ± 0.46	0.63 ± 0.49	0.41 ± 0.40	0.40 ± 0.39
P-value		0.001	<0.001	<0.001
95%CI		[0.12, 0.47]	[0.34, 0.67]	[0.35, 0.68]
IOP (Mean ± S.D.)	25.07 ± 12.66	10.88 ± 5.96	12.14 ± 6.01	12.75 ± 2.83
P-value		<0.001	<0.001	<0.001
95%CI		[8.64, 19.73]	[8.37, 17.48]	[7.76, 16.88]
Number of types of glaucoma medications (Mean ± S.D.)	2.86 ± 1.33	1.60 ± 1.39	1.46 ± 1.17	1.53 ± 1.13
P-value		<0.001	<0.001	<0.001
95%CI		[0.57, 1.93]	[0.74, 2.05]	[0.65, 2.00]
Number of drops of glaucoma medications (Mean ± S.D.)	3.93 ± 2.18	1.85 ± 1.78	1.68 ± 1.16	1.64 ± 1.12
P-value		<0.001	<0.001	<0.001
95%CI		[1.09, 3.06]	[1.37, 3.13]	[1.35, 3.22]

When considering the division of patients based on diagnosis, they can be divided into 3 groups as follows: Primary angle closure glaucoma (PACG) group, consisting of 11 patients, accounting for 39.28%, with more females than males. The average age is 59.81 years, the visual acuity (VA) is on average Logmar 1.10, and the average intraocular pressure is 21.63 mmHg. The average number of types of glaucoma medications used is 3.27, with a quantity of 4.45 drops per day. Acute angle closure (AAC) group that responded to treatment, consisting of 6 patients, accounting for 21.43%, with an equal number of females and males. The average age is 59.50 years, the visual acuity (VA) is on average Logmar 0.75, and the average intraocular pressure is 12.83 mmHg. The average number of types of glaucoma medications used is 2.17, with a quantity of 2.67 drops per day. Refractory acute angle closure group that did not respond to treatment, consisting of 12 patients, accounting for 39.28%, with more females than males. The average age is 58.63 years, the visual acuity (VA) is on average Logmar 0.86, and the average intraocular pressure is 35.18 mmHg. The average number of types of glaucoma medications used is 2.82, with a quantity of 4.09 drops per day.

Table 3: General information of patients who underwent phacoemulsification with goniosynechialysis classified by diagnosis

General information	PACG	AAC	Refractory AAC
Sex			
Male	1 (9.09%)	3 (50.00%)	3 (27.27%)
Female	10 (90.91%)	3 (50.00%)	8 (72.73%)
Age (Mean ± S.D.)	59.81 ± 6.86	59.50 ± 7.68	58.63 ± 9.85
Visual acuity Logmar (Mean ± S.D.)	1.10 ± 0.46	0.75 ± 0.21	0.86 ± 0.54
IOP (Mean ± S.D.)	21.63 ± 7.94	12.83 ± 5.70	35.18 ± 11.75
History of previous treatment for glaucoma			
Laser peripheral iridotomy	9 (81.82%)	2 (33.33%)	7 (63.64%)
Laser Iridoplasty	1 (9.09%)	3 (50.00%)	3 (27.27%)
Trabeculectomy	1 (9.09%)	0	0
Number of types of glaucoma medications (Mean ± S.D.)	3.27 ± 1.00	2.17 ± 1.32	2.82 ± 1.54
Number of drops of glaucoma medications (Mean ± S.D.)	4.45 ± 1.43	2.67 ± 1.75	4.09 ± 2.81

In the PACG group, the pre-operative visual acuity (VA) was measured as Logmar 1.10 ± 0.46, and after 3 months of treatment, it improved to Logmar 0.47 ± 0.53 (p-value <0.001, 95%CI [0.38, 0.86]). The pre-operative intraocular pressure (IOP) was recorded as 21.63 ± 7.94 mmHg, and at the 3rd month of treatment, it decreased to 12.18 ± 3.28 mmHg (p-value <0.001, 95%CI [4.53, 14.38]). The average number of types of glaucoma medications used before the surgery was 3.27 ± 1.00, and the average number of drops of glaucoma medications used was 4.45 ± 1.43. After 3 months of treatment, these numbers decreased to 2.00 ± 0.89 (p-value <0.001, 95%CI [0.83, 1.71]) and 2.09 ± 0.83 (p-value <0.001, 95%CI [1.61, 3.12]), respectively.

In the AAC group, the pre-operative visual acuity (VA) was measured as Logmar 0.75 ± 0.21, and after 3 months of treatment, it improved to Logmar 0.36 ± 0.34 (p-value 0.005, 95% CI [0.14, 0.63]). The pre-operative intraocular pressure (IOP) was recorded as 12.83 ± 5.70 mmHg, and after 3 months of treatment, it decreased to 11.83 ± 1.72 mmHg (p-value 0.307, 95%CI [-3.79, 5.79]). The average number of types of glaucoma medications used before the surgery was 2.17 ± 1.32, and the average number of drops of glaucoma medications used was 2.67 ± 1.75. After 3 months of treatment, these numbers decreased to 0.66 ± 1.03 (p-value 0.061, 95%CI [-0.57, 3.57]) and 0.42 ± 1.03 mmHg (p-value 0.051, 95%CI [-0.57, 4.57]), respectively.

In the Refractory AAC group, the pre-operative visual acuity (VA) was measured as Logmar 0.86 ± 0.54, and after 3 months of treatment, it improved to Logmar 0.36 ± 0.24 (p-value 0.010, 95%CI [0.10, 0.89]). The pre-operative intraocular pressure (IOP) was recorded as 35.18 ± 11.75 mmHg, and after 3 months of treatment, it decreased to 13.81 ± 2.71 mmHg (p-value <0.001, 95% CI [13.60, 29.12]). The average number of types of glaucoma medications used before the surgery was 2.82 ± 1.54, and the average number of drops of glaucoma medications used was 4.09 ± 2.81. After 3 months of treatment, these numbers decreased to 1.54 ± 1.21 (p-value = 0.055, 95%CI [-0.35, 2.89]) and 1.72 ± 1.19 (p-value 0.021, 95%CI [0.11, 4.62]), respectively.

Table 4 : shows the results of treatment with phacoemulsification with goniosynechialysis classified by diagnosis.

PACG	Pre-operative	1st week	1st month	3rd month
Visual acuity Logmar (Mean ± S.D.)	1.10 ± 0.46	0.56 ± 0.52	0.52 ± 0.53	0.47 ± 0.53
P-value		0.002	<0.001	<0.001
95%CI		[0.23, 0.86]	[0.33, 0.84]	[0.38, 0.86]
IOP (Mean ± S.D.)	21.63 ± 7.94	12.45 ± 8.00	11.81 ± 3.84	12.18 ± 3.28
P-value		0.019	0.002	<0.001
95%CI		[0.63, 17.73]	[4.15, 15.49]	[4.53, 14.38]
Number of types of glaucoma medications (Mean ± S.D.)	3.27 ± 1.00	2.00 ± 1.54	2.09 ± 0.94	2.00 ± 0.89
P-value		0.004	<0.001	<0.001
95%CI		[0.41, 2.12]	[0.67, 1.69]	[0.83, 1.71]
Number of drops of glaucoma medications (Mean ± S.D.)	4.45 ± 1.43	2.55 ± 2.11	2.18 ± 0.87	2.09 ± 0.83
P-value		0.008	<0.001	<0.001
95%CI		[0.45, 3.36]	[1.42, 3.13]	[1.61, 3.12]

AAC	Pre-operative	1st week	1st month	3rd month
Visual acuity Logmar (Mean ± S.D.)	0.75 ± 0.21	0.72 ± 0.51	0.31 ± 0.37	0.36 ± 0.34
P-value		0.425	0.006	0.005
95%CI		[-0.36, 0.42]	[0.15, 0.72]	[0.14, 0.63]
IOP (Mean ± S.D.)	12.83 ± 5.70	9.83 ± 4.07	11.50 ± 2.42	11.83 ± 1.72
P-value		0.116	0.254	0.307
95%CI		[-2.67, 8.67]	[-3.48, 6.15]	[-3.79, 5.79]
Number of types of glaucoma medications (Mean ± S.D.)	2.17 ± 1.32	1.00 ± 1.09	0.83 ± 0.98	0.66 ± 1.03
P-value		0.067	0.060	0.061
95%CI		[-0.51, 2.85]	[-0.50, 3.17]	[-0.57, 3.57]
Number of drops of glaucoma medications (Mean ± S.D.)	2.67 ± 1.75	1.00 ± 1.09	1.00 ± 1.09	0.42 ± 1.03
P-value		0.053	0.053	0.051
95%CI		[-0.50, 3.83]	[-0.5, 3.83]	[-0.57, 4.57].

Refractory AAC	Pre-operative	1st week	1st month	3rd month
Visual acuity Logmar (Mean ± S.D.)	0.86 ± 0.54	0.63 ± 0.50	0.38 ± 0.24	0.36 ± 0.24
P-value		0.040	0.012	0.010
95%CI		[-0.03, 0.49]	[0.09, 0.88]	[0.10, 0.89]
IOP (Mean ± S.D.)	35.18 ± 11.75	9.88 ± 4.39	12.81 ± 8.88	13.81 ± 2.71
P-value		<0.001	<0.001	<0.001
95%CI		[17.41, 33.19]	[15.57, 29.15]	[13.60, 29.12]
Number of types of glaucoma medications (Mean ± S.D.)	2.82 ± 1.54	1.54 ± 1.37	1.18 ± 1.25	1.54 ± 1.21
P-value		0.050	0.021	0.055
95%CI		[-0.29, 2.84]	[0.06, 3.20]	[-0.35, 2.89]
Number of drops of glaucoma medications (Mean ± S.D.)	4.09 ± 2.81	1.64 ± 1.57	1.55 ± 1.29	1.72 ± 1.19
P-value		0.014	0.011	0.021
95%CI		[0.30, 4.60]	[0.43, 4.66]	[0.11, 4.62]

Discussion

Goniosynechialysis is a procedure that involves the separation of adhesions between the iris and trabecular meshwork, improving drainage and decreasing intraocular pressure. Our study aimed to evaluate the changes in intraocular pressure and glaucoma medications usage following the treatment of angle closure patients using phacoemulsification with goniosynechialysis.

In our study, the number of female participants exceeded that of male participants, with a ratio of females to males of 3:1. The mean age of the participants was 59.28 years, with an average intraocular pressure (IOP) of 25.07 mmHg. The mean number of types of glaucoma medications used was 2.86 ± 1.33, and the mean number of drops of glaucoma medications used was 3.93 ± 2.18. Additionally, 50% of the participants were taking oral glaucoma medications. At the 3rd month of treatment, we observed a decrease in average intraocular pressure from 25.07 mmHg to 12.75 mmHg. Moreover, the average number of types of glaucoma medications decreased from 2.86 to 1.53, and the average number of drops of glaucoma medication decreased from 3.93 to 1.64. These findings suggest a positive therapeutic effect of the treatment on the participants' intraocular pressure and medications requirements, which was similar to other studies.[13-16]

When analyzing the patient groups based on their diagnosis, it was noted that the AAC group had a smaller number of participants compared to the other groups. The age distribution was similar across all groups. However, the refractory acute angle closure group exhibited higher intraocular pressure (IOP) levels compared to the other groups. Additionally, both the number of types and drops of glaucoma medication were highest in the refractory acute angle closure group, followed by the PACG group. The AAC group had relatively lower levels of glaucoma medication compared to the other two groups. Our participants were able to discontinue oral glaucoma medications within the first week following surgery.

In the PACG group, the average intraocular pressure was reduced by 9.45 mmHg using an average of 2.00 types of glaucoma medications and 2.09 drops at the 3rd month after surgery. The AAC group, which responded to medication, showed a decrease in intraocular pressure by an average of 1 mmHg using an average of 0.66 types of glaucoma medications and 0.42 drops at the 3rd month after surgery. The Refractory AAC group demonstrated the greatest reduction in intraocular pressure, with an average decrease of 21.37 mmHg using an average of 1.54 types of glaucoma medications and 1.72 drops at the 3rd month after surgery. These findings align with previous studies,[12-17] which also reported similar outcomes. Moreover, the reduction in intraocular pressure was more pronounced in the acute angle closure group.[16]

Table 5: presents the intraocular pressure (IOP) before and after surgery in comparison to another study.

	Before Surgery	Final Examination
Our study	25.07 ± 12.66	12.75 ± 2.83
Wanichwecharungruang 2021	24.5	12
Husain 2019	22.9 ± 5.3	15.9 ± 4.5
Moghimi 2015	23.3 ± 7.3	14.5 ± 2.5
Tun 2015	21.82 ± 5.81	14.36 ± 2.98
Verma 2010	29.68 ± 8.73	13.7 ± 2.89
Teekhasaenee 1999	29.7 ± 7.9	13.2 ± 2.9

Table 6 : presents the number of glaucoma medications before and after surgery in comparison to another study.

	Before Surgery	Final Examination
Our study	2.86 ± 1.33	1.53 ± 1.13
Wanichwecharungruang 2021	3	0
Husain 2019	1.9 ± 0.9	0.6 ± 1.2
Moghimi 2015	1.7 ± 1.1	0.4 ± 0.8
Tun 2015	1.45 ± 0.93	0.09 ± 0.3
Teekhasaenee 1999	2.4 ± 0.9	0.1 ± 0.3

The average visual acuity of patients improved from Logmar 0.92 to Logmar 0.40, which is a good result of cataract surgery. This is a reduction of complications compared to other types of surgical treatment to lower intraocular pressure, such as Trabeculectomy,[8,9] which can lead to postoperative cataract formation and more severe complications. In our study, we had complications of excessive bleeding in the anterior chamber of the eye in one case, and plasmoid reaction in four cases, which was also found in other studies.[14-16] In our study all complications were completely resolved.

When considering efficacy in phacoemulsification with goniosynechialysis, we evaluated its impact on intraocular pressure (IOP), the number of glaucoma medications, and the type of glaucoma medications used. Our findings revealed that both the acute angle closure group and the refractory acute angle closure group showed greater effectiveness compared to the primary angle-closure glaucoma (PACG) group. We attribute this difference to the extensive presence of peripheral anterior synechiae (PAS) in the PACG group, which are chronic and cause more damage to the trabecular meshwork compared to the other groups that experienced acute angle closure. The efficacy of phacoemulsification with goniosynechialysis was also reported in another study and meta-analysis.[12-17] However, another study revealed that phacoemulsification alone can also decrease intraocular pressure (IOP) and has efficacy comparable to goniosynechialysis.[12]

Conclusion

According to our research, phacoemulsification with goniosynechialysis in angle closure is an effective alternative treatment for lowering intraocular pressure in patients with closed-angle glaucoma. This can reduce the need for multiple types and amounts of eye drops for patients, as well as less complications from other types of glaucoma surgeries such as trabeculectomy.

Conflict of Interest Declaration

The authors declare no conflict of interest and declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

References

1. Resnikoff S, Pascolini D, Etya'ale D, Kocur I, Pararajasegaram R, Pokharel GP, et al. Global data on visual impairment in the year 2002. Bull World Health Organ. 2004; 82:844-51. Epub 2004 Dec 14.
2. Tham YC, Li X, Wong TY, Quigley HA, Aung T, Cheng CY. Global prevalence of glaucoma and projections of glaucoma burden through 2040: a systematic review and meta-analysis. Ophthalmology. 2014;121(11):2081-90.
3. Asanathong D. Prevalence of Glaucoma Patient at Sisaket Hospital During World Glaucoma Day. MJSSBH. 2020;35(3):749-56.

4. European Glaucoma Society Terminology and Guidelines for Glaucoma. 4th Edition - Chapter 3: Treatment principles and options Supported by the EGS Foundation: Part 1: Foreword; Introduction; Glossary; Chapter 3 Treatment principles and options. Br J Ophthalmol. 2017;101(6):130-95.
5. Anderson DR, Jin JC, Wright MM. The physiologic characteristics of relative pupillary block. Am J Ophthalmol. 1991;111(3):344-50.
6. Husain R, Gazzard G, Aung T, Chen Y, Padmanabhan V, Oen FTS, et al. Initial management of acute primary angle closure: a randomized trial comparing phacoemulsification with laser peripheral iridotomy. Ophthalmology. 2012;119(11): 2274-81.
7. Lam DSC, Leung DYL, Tham CCY, Li FCH, Kwong YYY, Chiu TYH, et al. Randomized trial of early phacoemulsification versus peripheral iridotomy to prevent intraocular pressure rise after acute primary angle closure. Ophthalmology. 2008 ;115(7):1134-40.
8. Chen YY, Fan SJ, Liang YB, Rong SS, Meng HL, Wang X, et al. Laser Peripheral Iridotomy versus Trabeculectomy as an Initial Treatment for Primary Angle-Closure Glaucoma. J Ophthalmol. 2017;2761301.
9. Rajavi Z, Moezzi-Ghadim H, Kamrava K. The effect of trabeculectomy on cataract formation or progression. J Ophthalmic Vis Res. 2009;4(2):84-9.
10. Dada T, Bhartiya S, Begum Baig N. Cataract Surgery in Eyes with Previous Glaucoma Surgery: Pearls and Pitfalls. J Curr Glaucoma Pract. 2013;7(3):99-105.
11. Hansapinyo L, Choy BNK, Lai JSM, Tham CC. Phacoemulsification Versus Phacotrabeculectomy in Primary Angle-closure Glaucoma With Cataract: Long-Term Clinical Outcomes. J Glaucoma. 2020;29(1):15-23.
12. Yu JG, Zhao F, Xiang Y. Phacoemulsification with Goniosynechialysis versus Phacoemulsification Alone in Angle-Closure Glaucoma: A Meta-Analysis of Randomized Controlled Trials. J Ophthalmol. 2021;8831479.
13. Wang N, Jia SB. Phacoemulsification with or without goniosynechialysis for angle-closure glaucoma: a global Meta-analysis based on randomized controlled trials. Int J Ophthalmol. 2019;12(5):826-33.
14. Teekhasaenee C, Ritch R. Combined phacoemulsification and goniosynechialysis for uncontrolled chronic angle-closure glaucoma after acute angle-closure glaucoma. Ophthalmology. 1999; 106(4):669-75.
15. Wanichwecharungruang B, Phumratprapin C, Kongsomboon K, Seresirikachorn K. Real-world Surgical Outcomes of Primary Angle-closure Glaucoma. Clin Ophthalmol. 2021;15:2823-33.
16. Tian T, Li M, Pan Y, Cai Y, Fang Y. The effect of phacoemulsification plus goniosynechialysis in acute and chronic angle closure patients with extensive goniosynechiae. BMC Ophthalmol. 2019;19(1):65.
17. Husain R, Do T, Lai J, Kitnarong N, Nongpiur ME, Perera SA, et al. Efficacy of phacoemulsification alone vs phacoemulsification with goniosynechialysis in patients with primary angle-closure disease: a randomized clinical trial. JAMA Ophthalmol. 2019;137(10):1107-13.
18. Bourne RRA. Prevalence of glaucoma in Thailand: a population based survey in Rom Klao District, Bangkok. British Journal of Ophthalmology. 2003;87(9):1069-74.