ORIGINAL ARTICLE

Results of Combined Phacoemulsification and Goniosynechialysis in the Management of Refractory Acute Angle Closure Glaucoma in Ratchaburi Hospital

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Objective: To assess the effectiveness of combined phacoemulsification and goniosynechialysis (PE-GSL) of angle closure glaucoma in patients with uncontrolled intraocular pressure (IOP) and persistent peripheral anterior synechiae (PAS) initially presented with acute angle closure attack.

Materials and Methods: The present study was a retrospective cohort study of medical records of Thai glaucoma patients comprising 19 eyes of 19 patients (13 females and 6 males) with acute angle closure attacks. All patients were performed with PE-GSL

Results: There were statistically significant differences between preoperative and postoperative IOP, PAS, and the number of medications required for IOP control. Postoperative visual acuities were improved. At the final examination for each patient, IOP was 12.15±1.57 mmHg (range 10 to 16). The extent of recurrent PAS was 66.32±40.72° (range 0 to 90), and the number of antiglaucoma medications was 0 (range 0 to 2). IOP was less than 20 mmHg in 16 eyes (80%) without medications. Three eyes were controlled with medications. In the 16 eyes with successful PE-GSL, the mean time between the angle closure attack and surgery was 7.5±5.6 weeks.

Conclusion: PE-GSL are effective in decreasing IOP, PAS, and medications, as well as improvement of visual acuity in eyes with uncontrolled IOP and persistent PAS in patients who initially presented with acute angle closure attacks.

Keywords: Angle-closure glaucoma; Phacoemulsification; Goniosynechialysis; Cataract; IOP

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The primary cause of irreversible visual impairment and blindness worldwide is glaucoma[1]. Let alone in Asia has been accounting for nearly 60% of total glaucoma cases in the world[2-5]. A worldwide analysis found that primary angle closure glaucoma (PACG) occurred in Asia in 1.09%, slightly higher, in comparison to the estimate in the current analysis of 0.73%. With an adjustment of age and gender, PACG prevalence was higher in East than in Southeast Asia[6]. Although in the developed world, open-angle glaucoma is more common, angle-closure glaucoma may result in greater morbidity including bilateral blindness.

Glaucoma is divided into open angle and closed angle at the anterior chamber angle. There are several reasons for PACG, but one is the extent of permanent peripheral anterior synechiae (PAS) closing asymptotically. The anterior chamber narrows progressively and causes the pupillary block and subsequently an escalation in intraocular pressure (IOP).

The anterior chamber angle is closed permanently by PAS in chronic angle-closure glaucoma[7]. IOP control after eradication of appositional closure depends on the extent of damage to the trabecular meshwork, which may be associated with the extent of PAS. Intraocular pressure is usually elevated when the angle is closed by PAS at more than 180°. When the angle is closed more than 270°, medical therapy is usually ineffective and then it becomes necessary for filtering surgery.

It is confirmed that controlling the level of IOP leads to a reduction in the development of glaucoma. If the medication had little effort to treat angle-closure glaucoma, the major surgical therapies attempt to widen the angle and increase the aqueous fluid being

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drained by the antiglaucoma procedure, for instance, trabeculectomy, as well as lens extraction[8].

The prominent causes of visual impairment for elders are PACG with coexisting lens opacity, which would especially affect females in Asia[3]. Following prior studies, the combination of cataract extraction and trabeculectomy leads to a more significant decrease in IOP after the surgery, however, there could be more postoperative complications[9]. It is indicated in studies that phacoemulsification (PE) alone with implantation of a foldable intraocular lens (IOL) is a conservative treatment to deepen the anterior chamber depth (ACD) and reduce IOP[10-12]. Goniosynechialysis (GSL) is estimated at 80% successful in eyes if the PAS has been present for less than one year[13]. In 1984, GSL was first described as a procedure by Campbell and Vela[13]. GSL was performed with PE in 1999[14], which has the potential to be an economic alternative for surgeons to decrease IOP instead of trabeculectomy. Studies suggest that to reduce IOP, PE-GSL is a more effective and safe treatment than routine cataract extraction alone[15-19]. Nevertheless, trials found that there is no advantage of the combination procedure to control the IOP appropriately[20].

The present study was to assess the effectiveness of PE-GSL in angle-closure glaucoma patients who had uncontrolled IOP and persistent PAS in patients who had initially presented with acute angle closure attack.

Materials and Methods

Patients

The present study was a retrospective cohort study of medical records of the glaucoma patient with acute angle closure glaucoma. The patients were treated consecutively at the Glaucoma service at Ratchaburi Hospital between January 2019 and December 2021. The study has been approved by the Ethical Committee of the Director of Ratchaburi Hospital (RBHEC 024/65).

The population of the present study comprised 19 eyes of 19 Thai patients, thus, 13 females and 6 males, with acute angle closure glaucoma who have been through a successful treatment with laser peripheral iridotomy (LPI) and argon laser peripheral iridoplasty (ALPI) but continued to have uncontrolled IOP of 21 mmHg or greater (Figure 1). They were receiving antiglaucoma medication. They presented with at least 180° of synechial angle closure.

The demographics and baseline characteristics of the patients included age, gender, Snellen chart best-corrected visual acuity (BCVA) converted to logMAR unit, IOP as measured by Goldman applanation tonometer, and antiglaucoma medications were recorded (Table 1). Goldmann 4-mirror lens was used to perform gonioscopy by an experienced examiner under dark conditions at high magnification (×16). The existence of PAS was determined by indentation gonioscopy with the use of a Volk G-4 Gonio lens and was defined as abnormal adhesions of the iris to the angle that was at least half a clock hour in width and was present to the level of the anterior trabecular meshwork or higher. The degree of angle closure was used to measure the extent of PAS (°) across the superior, inferior, nasal, and temporal quadrants. The attack-surgery interval was recorded according to the patient's memories and the history of their medical records, which included patients with acute angle closure glaucoma.

Patients who met the inclusion criteria had to be at least 40 years old and had been medically treated for their angle closure glaucoma at the time of presentation. Despite having had both LPI and ALPI, all patients who had at least 180° of PAS and an uncontrolled IOP of at least 21 mmHg continued

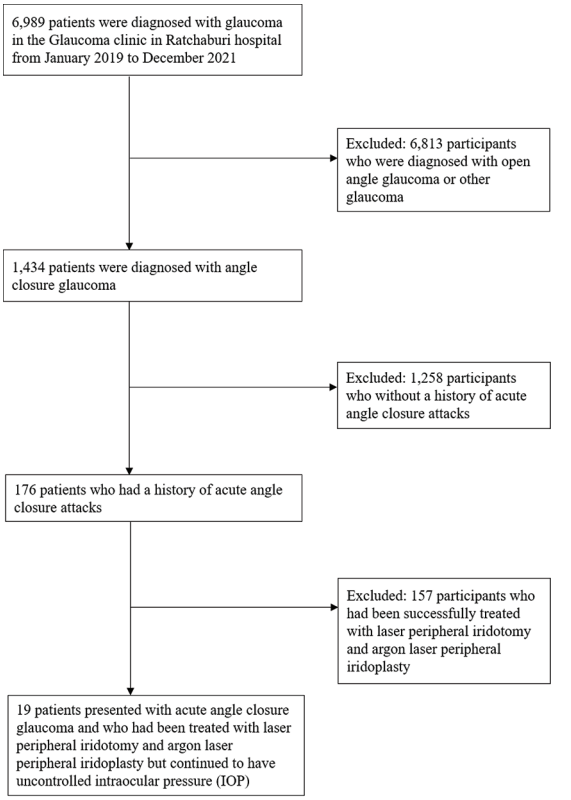

Figure 1. Flow chart.

to take antiglaucoma drugs. Within six months of the acute angle closure glaucoma attack, these eyes underwent a combination of PE-GSL and posterior chamber IOL implantation.

Patients having a history of uveitis, rubeosis iridis, prior ocular trauma, and no prior ocular surgery other than surgical peripheral iridotomy were excluded from the study. Patients with severe glaucomatous cupping, a hazy history of an acute attack, an acute attack that happened more than six months ago, or a lack of classic acute attack symptoms such as sphincter paralysis or glaukomflecken. Eyes with lens displacement or malignant glaucoma, as well as those with asymmetric ACDs that differed by greater than 0.3 mm or intumescent cataracts (phacomorphic glaucoma) were also excluded.

Examination

BCVA was determined using LogMAR chart records, slit lamp, and fundus examinations, IOP determination using Goldmann applanation tonometry, the degree of PAS determined using gonioscopy, and measurements of axial length (AXL), lens thickness (LT), and ACD using IOL master 700 (Carl Zeiss Meditec; Germany) were also performed. Before surgery, baseline exams were performed on all patients. Following the procedure, patients underwent follow-up exams on the first day, the first week, the first month, after three and six months, and after the first, second, and third year after the operation. Each post-surgical follow-up appointment included a routine ocular examination. Every follow-up appointment beginning the first week following surgery included the BCVA, IOP, and gonioscopy.

Surgical procedure

One surgeon did every operation while under subconjunctival anesthetic. Clear corneal incision PE was carried out with an IOL implanted in the capsular bag. To deepen the peripheral anterior chamber, viscoelastic was injected into the anterior chamber. To see the angle, the cornea was placed under the operating microscope with the Mori Upright Surgical Gonio Lens (Ocular Instruments, Bellvue, WA, USA) attached. Through the primary incision and the side incision, the trabecular meshwork was softly disrupted under direct observation by gently pressing down on the periphery of the iris. The viscoelastic was replaced with balanced salt solution after the treatment, and the corneal wound was stitched with 10-0 nylon suture after being sealed by corneal stromal hydration. Following surgery, all patients were given topical steroids and antibiotics that were tapered over a period of four to six weeks depending on the clinical requirement. Postoperatively, antiglaucoma drugs were stopped and reintroduced, as necessary.

Table 1. Baseline patient characteristics

Number of patients	19
Age (year); mean±SD	61.83±8.55
Sex; n (%)	
Male	6 (31.6)
Female	13 (68.4)
Mean BCVA (LogMAR); mean±SD	1.29±0.60
Mean IOP (mmHg); mean±SD	49.26±9.68
Number of medications; median (range)	4 (2 to 4)
PAS (degree); mean±SD	331.58±42.98
Axial length (mm), mean±SD	22.75±0.98
Anterior chamber depth (mm), mean±SD	2.23±0.23
Lens thickness (mm), mean±SD	5.15±0.34
Lens power (diopter), mean±SD	22.68±2.60

BCVA=best-corrected visual acuity; IOP=intraocular pressure; PAS=peripheral anterior synechiae; SD=standard deviation

Table 2. Preoperative and postoperative data

	Preoperative	Postoperative	p-value
IOP (mmHg); mean±SD	49.26±9.68	12.15±1.57	<0.0001
PAS (degree); mean±SD	331.58±42.98	66.32±40.72	<0.0001
Medications; median (range)	4 (2 to 4)	0 (0 to 2)	
BCVA (LogMAR); mean±SD	1.29±0.60	0.32±0.22	<0.0001

IOP=intraocular pressure; PAS=peripheral anterior synechiae; BCVA=best-corrected visual acuity

p<0.0001, paired t-test

Statistical analysis

PASW Statistics for Windows, version 18.0 (SPSS Inc., Chicago, IL, USA) was used for the statistical analysis. and then mean ± standard deviation was calculated. The study of continuous variable changes before and after surgery was done using a paired Student t-test. A 2-tailed test was used for all measurements, and for measurable variables, a p-value of less than 0.05 was deemed significant.

Results

Between preoperative and postoperative IOP, PAS, the number of drugs needed to regulate IOP, and visual acuity, there was a statistically significant difference (Table 2). Visual acuities after surgery were enhanced. No patient's BCVA had gotten worse. Follow-up on average lasted 28.36±9.04

months (range 16 to 40 months). IOP was 12.15±1.57 mmHg for each patient at the last evaluation (range 10 to 16 mmHg). The range of recurrent PAS was 66.32±40.72° (from 0° to 90°), and antiglaucoma medications were taken 0 (range 0 to 2). In the third year following surgery, no patients were lost to follow-up. In 16 eyes (80%) without medication, IOP was less than 20 mmHg. Three eyes required medication for management. The mean interval between the angle closure attack and surgery was 7.5±5.6 weeks in the 16 eyes with successful PE-GSL. According to the examiner's clinical assessment, patients who needed antiglaucoma drugs started taking them during the first two months following surgery. After the first three months, those who were able to stop taking their drugs did not require it again. In this investigation, problems were discovered. After surgery, plasmoid reactions occurred in three patients. The most frequent side effect was a plasmoid or fibrinoid reaction. After the procedure, no patients had hyphema. No patients needed to re-operate. Figure 2 and 3 depicted the post-operative reduction in IOP and the number of medications. It also demonstrates that IOP was kept in good condition throughout the follow-up time.

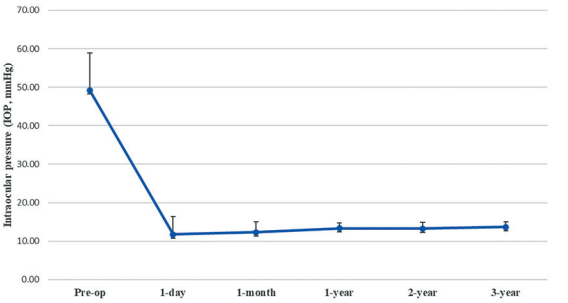

Figure 2. Compare mean of intraocular pressure of all angle closure glaucoma patients for each time point from preoperative time to 3 years after surgery.

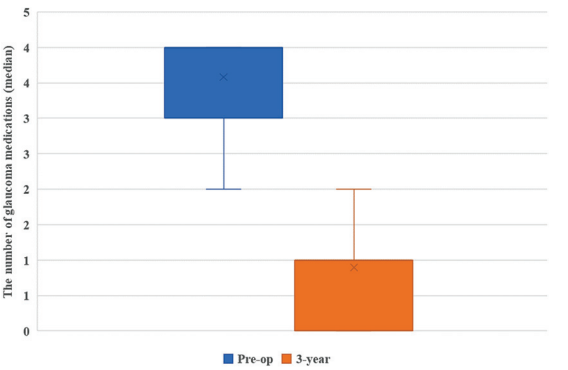

Figure 3. Results of number of glaucoma medications of all angle closure glaucoma patients from preoperative time to 3 years after surgery.

Discussion

Medication and laser therapy are successful treatments for acute angle-closure glaucoma (Nd:YAG LPI or ALPI). When PAS closes the angles by more than 180°, IOP is frequently increased. Additionally, when PAS extension is greater than 270°, the drugs are mostly ineffective, and trabeculectomy is practically required[14]. However, postoperative problems include a shallow anterior chamber, aqueous misdirection, and bleb issues that may be increased with trabeculectomy. The opacity of the lens, which causes pupillary block, is a major factor in the pathophysiology of angle-closure glaucoma. Cataract surgery can deepen the anterior chamber, broaden the chamber angle, or even reopen it[21]. To treat chronic angle closure glaucoma, GSL involves pulling the periphery of the iris away from the angles and restoring trabecular function before irreversible structural alterations occur. In patients with closed angles caused by PAS, uncontrolled IOP, or drug resistance, this treatment effectively lowers IOP. Patients with PAS that have been present for less than a year can benefit from the operation[13]. However, the mechanism producing synechial closure is equally important for the long-term success of GSL. If the mechanism is still in place, PAS may reappear. Bleeding, iridodialysis, and significant postoperative inflammation are complications.

In the present study, PE-GSL was demonstrated to be effective when traditional treatments such as antiglaucoma medications, laser therapy (Nd:YAG LPI or ALPI) failed to stop the angle closure attack. IOP dropped to less than or equal to 21 mmHg in 16 of 19 individuals (80%), with a 75% drop in mean IOP. Additionally, after PE-GSL, the median number of antiglaucoma medications per patient dropped from 4 in the pre-treatment to 0 in the post-treatment, a 90% decrease. The author found that the delay between the time of the attack and the time of operation is a major predictive factor for IOP control. The patients in the present study had an interval between angle closure attack and time of PE-GSL (7.5±5.6 weeks in the 16 eyes with successful PE-GSL). The prognosis is better the shorter the peripheral synechial closure occurs. The author is therefore interested in how the timing of an attack and a surgery relate to one another. The only significant consequence in the present trial was anterior chamber fibrinous reactivity, which is consistent with prior

investigations. Therefore, PE-GSL is a less invasive technique performed safely by cataract surgeons.

After PE-GSL, visual acuity also improved, with the mean logMAR value reducing from 1.29 to 0.32. Visual acuities were 100% better after surgery. No patient's best-corrected visual acuity had gotten worse[22]. Pigment builds up and the trabecular meshwork degenerates as a result of acute angle closure. The longer the attack lasts, the more harm it causes to the trabecular meshwork's persistent PAS development. Cataract surgery can be used to treat angle-closure glaucoma by reversing the angle-crowding mechanism in eyes with the condition, which reduces iridotrabecular contact[23].

Earlier prospective and retrospective studies have demonstrated the PE-GSL method reduces IOP for acute angle closure[8]. The success of surgery is influenced by preoperative factors, such as the duration and amount of PAS[14]. According to research by Teekhasaenee and Ritch, the success rate of PE-GSL remained consistent for up to six years after the third postoperative month and suggested that long-term success is achievable without raising the risk of failure[14]. For individuals who previously had a normal trabecular meshwork recently progressed synechial closure following a patent LPI or ALPI, GSL is a promising alternative. The meta-analysis discovered that PE-GSL has no adverse effects on angle-closure glaucoma patients, consequently, PE-GSL is advised[21]. Both PE-GSL and PE alone demonstrated a significantly decreased IOP and the number of medications. However, PE-GSL had an advantage over PE alone in separating PAS. Equally low postoperative complication rates were seen for both treatments. Kameda et al. demonstrated that with a mean follow-up of 40 months following PE-GSL, the chance of treatment success for all 109 eyes was 85.9%[24]. During a mean follow-up of 20.8 months, Teekhasaenee and Ritch. reported an absolute success rate of 90.4% after PE-GSL in eyes with acute angle closure(14). According to research, IOP can continue to decrease over three years with long-term follow-up after PE-GSL. However, the IOP may be increasing as a result of the PAS reappearing[21]. Therefore, patients should be routinely monitored to assess the anterior chamber angle and IOP measurement.

The present study has limitations, including a small sample size of 19 patients, a brief follow-up period with a mean follow-up of 28.36±9.04 months and ranging from 16 to 40 months, and the absence of a control group to compare this sample with a comparable group of patients who may have undergone other procedures.

To conclude, in patients who initially presented with an acute angle closure attack, simultaneous PE, and GSL are beneficial in lowering IOP, PAS, medications, and improving visual acuity in eyes with uncontrolled IOP and persistent PAS.

What is already known on this topic?

Patients with acute angle closure glaucoma have been through a successful treatment with LPI and ALPI to deepen the ACD and reduce IOP.

What does this study add?

PE-GSL is effective in decreasing IOP, PAS, and medications, as well as improvement visual acuity in eyes with uncontrolled IOP and persistent PAS in patients who had initially presented with acute angle closure attacks.

Conflicts of interest

The author declares no conflict of interest.

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