ORIGINAL ARTICLE

EFFECT OF PHACOTRABECULECTOMY ON OCULAR BIOMETRIC, GONIOSCOPIC AND INTRAOCULAR PRESSURE IN PATIENTS WITH PRIMARY ANGLE CLOSURE GLAUCOMA

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ABSTRACT

Objectives: The objective of this study is to have an expanded evaluation on the effect of phacotrabeculectomy on ocular biometric (ACD/anterior chamber depth, lens thickness), gonioscopic and intraocular pressure (IOP) in primary angle closure glaucoma (PACG).

Methods: A cohort study of PACG patient who underwent phacotrabeculectomy from September 2018-March 2019 at Dr.Kariadi hospital. Preoperative secondary data of baseline IOP, ACD, lens thickness, and gonioscopy were obtained from medical record. Postoperative primary data of IOP, ACD, and gonioscopy were obtained 2 weeks after surgery.

Results: Thirty eyes from 23 patients had preoperative and postoperative mean IOP (26,20±2,24 and 18,35±2,49), mean ACD (2,46±0,37 and 3,40±0,40), mean gonioscopic score (4,97±0,96 and 8,33±1,63), mean preoperative lens thickness (4,58±0,39). There were significant differences between IOP, ACD and gonioscopic score (<0,001) before and after phacotrabeculectomy. The greater lens thickness was associated with IOP reduction (<0,001 r=0,756), increased ACD (0,005 r=0,498), and increased gonioscopic score (<0,001, r=0,802). The positive correlation can be seen between gonioscopic score and ACD (<0,001 r=0,666) and the negative correlation between IOP and ACD (<0,001 r=0.683), IOP and gonioscopic score (<0,001 r=0,876).

Conclusion: Phacotrabeculectomy may be effective in reducing IOP, increasing ACD, and gonioscopic scores significantly in PACG patients. Lens thickness may be positively correlated with IOP reduction, increased ACD, and gonioscopic scores after phacotrabeculectomy.

Keywords: PACG, phacotrabeculectomy, ocular biometrics, gonioscopic, intraocular pressure

INTRODUCTION AND OBJECTIVE

It has been estimated that 67 million people worldwide are affected with a primary glaucoma and one-third have primary angle closure glaucoma (PACG).[1] This condition is especially common in people of East Asian origin and can potentially lead to blindness.[1,2] The crystalline lens of the eye play a major role in the pathophysiology of this disease. With increasing age, the crystalline lens tends to become more opaque and swell, leading to a thicker

lens. Data suggests the shallowing of the anterior chamber occurs from intumescent cataract or plateau-iris syndrome. Combining lens extraction in PACG (primary angle closure glaucoma) patients with established synechial angle-closure is essential not only for visual rehabilitation, but forming a wider ACD, releasing the pupil block and reopening the anterior chamber angle. Phacotrabeculectomy has demonstrated higher effectiveness than sequential surgery with the result of regaining control of IOP.[4,5]

When performed prior to cataract surgery, trabeculectomy increases the risk of cataract formation by up to 78%, while subsequent cataract surgery may increase the risk of elevated intraocular pressure (IOP) or trabeculectomy failure.[5] When cataract surgery alone is performed in glaucoma patients, an early postoperative IOP spike sometimes occur, requiring medical treatment. Therefore, phacotrabeculectomy, a procedure that combine the management of these two conditions together in one surgery, may be considered in these situations. Previous studies have shown that phacotrabeculectomy can provide an IOP-lowering effect that is not inferior to that of trabeculectomy alone, and visual and refractive outcomes following this procedure are comparable to those obtained with phacoemulsification alone.[5,6] Biometry and clinical examination of PACG patients identifies the anatomic risk factors for angle closure as the lens can have an anterior displacement pushing the peripheral iris (angle crowding) against the trabecular meshwork. This allows for long-standing inflammatory peripheral anterior synechia consistent with previous studies that reports lensectomy combined with trabeculectomy or goniosynechialysis precedes cataract surgery alone.[7]

The objective of this study is to have an expanded evaluation on the effect of phacotrabeculectomy on ocular biometric (ACD/anterior chamber depth, LT/lens thickness), gonioscopic, and intraocular pressure (IOP) in PACG.

METHODS

Study design

This prospective single-center study comprised of PACG patients who underwent phacotrabeculectomy from September 2018-March 2019 at Dr.Kariadi hospital. Thirty eyes from 23 patients was included in the study. The hospital's ethics committee approved the study, and all patients provided informed consent.

Inclusion criteria were patients aged 35 years or older and scheduled for elective phacotrabeculectomy with PACG and visually significant cataract with visual acuity of less than 20/50 with an IOP of less than 25 mm Hg within 24h of presentation and after initial medical treatment. Exclusion criteria included underlying ocular comorbidity other than PACG

(uveitis, history of trauma or intraocular surgery, and intraoperative or postoperative complications; eg, posterior capsule tear; zonular dialysis; IOL tilting, subluxation or dislocation; prolonged postoperative inflammation).

Preoperative secondary data of baseline IOP, ACD, lens thickness, and gonioscopy are obtained from medical records. Postoperative primary data of IOP, ACD and gonioscopy were obtained 2 weeks after surgery.

Occludable Angle Measurement

A postoperative examination of the angle of the anterior chamber were performed approximately two weeks after surgery using the slit lamp gonioscopic method. A three mirror gonio-lens and a Thorpe Bausch and Lomb slit lamp were used. The investigator performed all slitlamp gonioscopy examinations using a Goldmann 3-mirror lens at 25 magnification under low ambient illumination. A narrow, 1.0 mm long vertical beam was used to examine the superior, inferior, nasal, and temporal quadrants to prevent pupil constriction, care was taken to prevent light from falling on the pupil. The grading according to Shaffer, in each eye, the mean angle width was calculated by adding the angle grade in all quadrants.

To obtain a Gonioscopic score quantitatively, the scoring method as follows was carried out (SL = 1, TM = 2, SS = 3, IP = 4). The total four angle gonioscopic score was calculated by adding the scores of each structure seen from gonioscopy examination.

Anterior Chamber Depth (ACD) and Lens Thickness (LT) Measurement

The ACD and lens thickness were measured pre and postoperatively using contact A-scan ultrasonography. All measurements were performed with the USG A-scan (Tomey,Inc.) using an immersion technique. Three independent measurements were taken in each eye by a skilled technician, the mean of 3 readings was used.

The following biometric measurements were recorded for each patient: ACD in millimeters, defined as the axial distance between the anterior surface of the cornea and the anterior surface of the lens; and LT in millimeters, defined as the axial distance between the anterior surface of the lens and the posterior surface of the lens.

Patient Assessment

Patients who fulfilled the selection criteria were recruited into the study and had a complete ocular examination. The corrected distance visual acuity (CDVA) measured with a Snellen chart. A detailed slitlamp examination was performed. The investigator performed

ocular biometric and IOP measurements throughout the study period. After topical anesthesia was instilled, the examiner measured IOP using a calibrated non-contact tonometer. The IOP was measured between 10 AM to noon at visit (2 weeks postoperatively).

Table 1. Patients' baseline characteristics

Variables		
Sex	Male	10
	Female	13
Age	31-40	2
	41-50	1
	51-60	12
	61-70	7
	>70	1
IOP	Pre op	26,20 mmHg
	Post op	18,34 mmHg
Lens thickness	Pre op	4,57 mm
Axial length	Pre op	23,91 mm
Anterior Chamber Depth	Pre op	2,46 mm
	Post op	3,40 mm
Gonioscopic score	Pre op	4,97
	Post op	8,33

STATISTICAL ANALYSIS

The Pearson product-moment correlation coefficient (r) was used to statistically evaluate each scattergram. The mean values of all measurements were also calculated. Because, the data were non-normal distribution data, Wilcoxon test were performed to establish whether there was a statistically significant difference between the values under study. A P-value less than 0.05 was considered statistically significant.

RESULT

Patient demographic information was obtained at the time of enrollment for each subject. Mean age was 57.53 years. Of 23 patients, 13 were women (56.52%) and 10 were men (43.47%) (Table 1). The mean of axial length 23.91 mm and the mean of lens thickness 4.57 mm. In the study group, the mean preoperative IOP was 26.20 mmHg and the mean postoperative IOP was 18.34 mmHg.

Table 2. All parameters preoperative and 2 weeks postoperative

Variables	Mean ± SD	p
IOP pre	26,20 ± 2,24	0,028
IOP post	18,35 ± 2,49	0,292*
ACD pre	2,46 ± 0,37	0,033
ACD post	3,40 ± 0,40	0,348*
GONIOS pre	4,97 ± 0,96	5 (4-8)
GONIOS post	8,33 ± 1,63	0,006
Delta IOP	7,85 ± 2,32	0,534*
Delta ACD	0,94 ± 0,32	0,069*
Delta GONIOS	3,37 ± 1,22	0,058*
Lens Thickness	4,58 ± 0,39	0,076*

*Normal (p > 0,05); Shapiro-wilk test

A comparison of intraocular pressure preoperatively and postoperatively was made in all cases. Thirty eyes from 23 patients had preoperative and postoperative mean IOP (26,20±2,24 and 18,35±2,49), mean ACD (2,46±0,37 and 3,40±0,40), mean gonioscopic score (4,97±0,96 and 8,33±1,63) respectively, mean preoperative lens thickness (4,58±0,39). (Table 2)

Table 3. Different Paired Test Wilcoxon

Variables	**Pre**	**Post**	**p**
IOP	25,4 (22,8 – 31)	18,74 (11,3 – 23,3)	<0,001*
ACD	2,34 (1,85 – 3,13)	3,42 (2,71 – 4,56)	<0,001*
GONIOS	5 (4 – 8)	8 (6 – 12)	<0,001*

* Significant (p < 0,05)

Wilcoxon test was performed for the non-normal distribution data. After surgery, the IOP decreased progressively and the mean decrease was statistically significant. There were significantly differences between IOP, ACD and gonioscopic score (<0,001) before and after phacotrabeculectomy. (Table 3)

Table 4. Pearson correlation test for the preoperative thickness less

Variables	p	R	
Delta IOP	<0,001	0,756	Significant, positive strong
Delta ACD	<0,001	0,498	Significant, positive moderate

Delta GONIOS	<0,001	0,802	Significant, positive very strong

The greater lens thickness was associated with IOP reduction (<0,0001 r=0,756), increased ACD (0,005 r=0,498), and increased gonioscopic score (<0,001, r=0,802).

Table 5. Pearson correlation test delta GONIOS for IOP delta

Variabel	Mean ± SD	r
Delta GONIOS	3,37 ± 1,22	0 0,876*
Delta IOP	7,85 ± 2,32	

*significant,positive,very strong

Table 6. Pearson correlation test delta GONIOS for ACD delta

Variabel	Mean ± SD	r
Delta GONIOS	3,37 ± 1,22	0 0,666*
Delta ACD	0,94 ± 0,32	

*significant,positive, strong

Table 7. Pearson correlation test delta ACD for IOP delta

Variabel	Mean ± SD	r
Delta ACD	0,94 ± 0,32	0 0,683*
Delta IOP	7,85 ± 2,32	

*significant,positive, strong

The positive correlation can be seen between gonioscopic score and ACD(<0,001 r=0,666) and the negative correlation between IOP and ACD (<0,001 r=0.683), IOP and gonioscopic score (<0,001 r=0,876). (Table. 5,6,7)

DISCUSSION

For medically-unresponsive PACG patient with established synechial angle closure and advanced GON (glaucomatous optic neuropathy), active management of the IOP is essential. Combined cataract extraction with trabeculectomy or sequential surgery has been suggested as a treatment option for glaucoma coexist cataract in the elderly population.[4]

Phacotrabeculectomy is common surgery for patients who have developed coincidence glaucoma and cataract. Many studies reported the effect of cataract surgery on ocular biometrics, but very few about phacotrabeculectomy (glaucoma-cataract surgery). [8-12] In our study, combined surgery with IOL implantation led to a mean IOP reduction of 7.85 mmHg, representing a 30.90% decrease from a mean preoperative IOP of 25.4 mmHg. Consistent with previous comparative studies, we found a greater IOP reduction after phacotrabeculectomy in

the PACG group. In a study by Lai et al,[12] the PACG group had a mean IOP reduction of 12.7 ± 8.3 mmHg, whereas the POAG group showed a mean IOP reduction of 5.0 ± 5.7 mmHg ($p < 0.05$). Rao et al, reported a mean IOP reduction of 8.1 ± 8.4 mmHg in PACG and 5.5 ± 7.3 mmHg in POAG ($p < 0.03$) after phacotrabeculectomy without MMC.[13] Tong and Miller found that sutureless phacoemulsification with foldable posterior chamber IOL implantation lowered IOP by 1.1 to 2.5 mm Hg during the first 6 months after surgery.[14] Gunning and Greve advocate cataract extraction with IOL implantation alone for acute ACG based on their finding that the procedure reduced IOP to the same extent as filtering surgery, but with fewer complications.[17]

The reduction in IOP may be due to the angle width increase and outflow of aqueous humor after cataract extraction and/or a functional filtering bleb. If the IOP is well controlled on a low dose of well-tolerated medication with mild glaucomatous damage, early cataract surgery alone may be a reasonable choice to increase the anterior chamber depth. When glaucoma is uncontrolled, despite maximum tolerable medical and laser therapy, the eyes may require filtering surgery first which has the greatest chance of providing long-term IOP control.[14,15]

The IOP showed considerable reduction in patients with a higher preoperative IOP. The amount of postoperative IOP reduction was directly related to the preoperative IOP in both groups. This is consistent with a study by Poley et al., which found that the decrease in IOP after phacoemulsification was proportional to the preoperative IOP; eyes with the highest preoperative IOP had the greatest decrease and eyes with the lowest preoperative IOP had a slight increase.[18] The exact mechanism of the decrease in IOP after phacoemulsification and IOL implantation is unknown. Previous findings suggest that capsulorhexis size has an effect. A 4.0 mm capsulorhexis places more traction on zonules and thus reduces IOP more than a 6.0 mm capsulorhexis.[19] Another explanation for the decrease in IOP after cataract extraction is the improvement in aqueous outflow resulting from the increased postoperative ACD, the increase opens the angle, especially in patients with a low aqueous outflow facility (occludable angle).[20]

The average lens thickness in our study was 4.58 mm, showed that the greater lens thickness was associated with IOP reduction (<0.0001), increased ACD (0.005), and increased gonioscopic score (<0.001). A thicker anterior–posterior lens diameter was associated with a shallower anterior chamber and a more significant difference in ACD in the occludable-angle group 2 weeks postoperatively. The shallower ACD in eyes with occludable angles is the result of an anatomic predisposition, a steeper anterior lens surface curvature, decreased ACD, a narrower chamber angle, and more anterior ciliary bodies; sometimes, it is genetically

predetermined.[14] The continuous increase in the anterior–posterior diameter of the crystalline lens throughout life results in a gradual decrease in ACD and volume. The lens growth causes progressive anterior chamber shallowing at a rate of approximately 0.35 to 0.50 mm over 50 years.[14,16]

In our study, the ACD was significantly deeper postoperatively, the mean increase at 2 weeks was 0,94 (40,17%) in the occludable angle. This is consistent with the study of Hayashi et al., in which the mean increase in ACD was 1.10 mm 8 weeks postoperatively.[16] We also found that the amount of increase in ACD postoperatively was inversely related to the preoperative ACD value. In the study by Hayashi et al., the width and depth of the anterior chamber angle in eyes with PACG increased significantly after cataract extraction and IOL implantation and was similar to that in eyes with open-angle glaucoma and in normal eyes; this is maybe the reason for the postoperative decrease in IOP in our study. [16] This finding is often seen in eyes with narrow angles, in which cataract extraction can permanently normalize IOP. Jahn found that small-incision cataract surgery significantly increases the anterior chamber depth and angle. Moreover, the change in angle width was greater in eyes that had a shallow angle preoperatively.[9]

In this study, the gonisocopic score increase 3.37 score (67.4%) from a mean preoperative score indicating an angle increase. This scoring system may assist the clinician to assess the potential for IOP reduction after combined surgery. To our knowledge, this is the first study to report the gonioscopic score before and after combine surgery in PACG patient. Collectively, these results indicate that phacotrabeculectomy might have greater influence in terms of lowering IOP and reducing the number of medications required for patients with PACG.

Our cohort was relatively small because of the scarcity of patients. Because of the unavailability of certain clinical equipment, ocular biometry measurements (ACD, LT, AL) were performed using contact A-scan ultrasonography, which is a limitation of our study.

CONCLUSION

In summary, phacotrabeculectomy can significantly change the ACD and IOP in patients with occludable angles. In our study, there were significantly differences between IOP, ACD and gonioscopic score before and after phacotrabeculectomy. The greater lens thickness was associated with IOP reduction, increased ACD and increased gonioscopic score The positive correlation can be seen between gonioscopic score and ACD and the negative correlation between IOP and ACD, IOP and gonioscopic score. Based on these findings, we

believe that combine surgery (phacotrabeculectomy) with foldable IOL implantation is an effective tool in lowering IOP, and increasing the anterior chamber depth. It may also prevent acute angle–closure attack in eyes with occludable angles. A larger study with longer follow-up and measurement with the Goldmann applanate tonometer as a gold standard device would be beneficial in determining the effect of phacoemulsification and IOL implantation in these eyes.

CONCLUSION

Citicoline supplementation tends to improve the Δ amplitude of P50 and N95 and Δ mean deviation in chronic phase NAION. The age and the number of risk factors are those that affect the increase of Δ amplitude P50. Citicoline supplementation did not show changes in retinal ganglion cell thickness. Citicoline supplementation can be used safely in chronic phase NAION.

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