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Study of Anterior Chamber Configuration with Panoramic Ultrasound Biomicroscopy in Chronic Angle-Closure Glaucoma and Co-Existing Age-Related Cataract after Phacoemulsification

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Abstract: To study the changes in anterior chamber configuration by panoramic ultrasound biomicroscopy. Phacoemulsification and IOL implantation were performed in 40 eyes in 40 cases with co-existing CACG and cataract and 40 eyes of 40 controls with age-related cataract. The anterior chamber diameter and Anterior Chamber Depth (ACD) were measured with panoramic ultrasound biomicroscopy before and 2 months after the surgery. The anterior chamber diameter in patients with CACG and co-existing cataract was 9.93±0.39 mm before surgery and 11.45±0.53 mm after surgery. The corresponding values found in controls were 11.47±0.62 mm and 11.93±0.39 mm. In both groups, the anterior chamber diameter was widened significantly 2 months after surgery and the ACD was deepened. Anterior chamber diameter in patients with CACG and co-existing cataract is less than that in patients with age-related cataract. After phacoemulsification and IOL implantation, the anterior chamber diameter is increased.

Key words: Anterior chamber diameter, microscopy, acoustic, phacoemulsification, glaucoma, angle-closure

INTRODUCTION

Phacoemulsification can be used to treat chronic angle-closure glaucoma patients with co-existing age-related cataract. By various means, ophthalmologists can detect postoperative anterior chamber is deepened after surgery and anterior chamber become open (Lai *et al*., 2006). Ultrasound Biomicroscopy (UBM) can be used to reveal the structure of anterior chamber and get clear 2-D images. However, it's unable to obtain an overall check by ordinary UBM scanning due to its limited scan range (Zhang and Xin, 2006). Here, researchers use panoramic ultrasound biomicroscopy to measure and evaluate the anterior chamber diameters before and after phacoemulsification in chronic angle-closure glaucoma patients co-existing with age-related cataract, aiming to observe the effects of phacoemulsification to the anterior chamber structure in these patients.

MATERIALS AND METHODS

Object: Collect 40 residential patients (40 eyes) in the hospital continuously (from June 2009 to September 2011) with the diagnose of chronic angle-closure glaucoma combined with age-related cataract which aged from 62-84, average 71.4±6.9 years old. In the same time period, collect 40 age-related cataract hospitalization patients (40 eyes) as control group, aged from 64-87, average 69.8±6.8 years. All the eyes elected must be the first time to receive intraocular surgery. Before phacoemulsification, detections of eyesight, intraocular pressure, anterior chamber angle lens and fundus examination were taken to confirm the diagnosis of chronic angle-closure glaucoma and age-related cataract according to diagnostic criteria and anterior chamber angle should be >180; age-related cataract in the control group also follows diagnostic criteria. All the patients were performed with the phacoemulsification combined with artificial lens implantation successfully with all the intraocular lenses implanted in phacocyst. Patients were excluded in this study with preoperative and postoperative complications such as capsular rupture, pupil shift or crystals adhesion, intraocular lens deviation.

Examination method: All the examinations were performed with the panoramic UBM SCAN1000 (Canada, OTI Inc.) with a 50 MHz transducer probe and penetration depth of 15 mm. The focal length is 15 mm and the axial resolution is 15.3 μm. Patient was in supine position, instilled with 0.5% lignocaine drops in conjunctival sac for surface anesthesia. Appropriate-sized eyecup was placed in conjunctival sac and probe was put in the inner water for detection. All the patients included took UBM examines twice (before and 2 months after operation, respectively). Results were processed by the original software in UBM device for measurement. Diameter of anterior chamber was defined as the mean distance between horizontal meridian and anterior horn fossae on two sides of vertical meridian (Fig. 1). Anterior chamber depth was defined as maximum distance between corneal vertex surface and front surface of lens/IOL optical part (Fig. 2).

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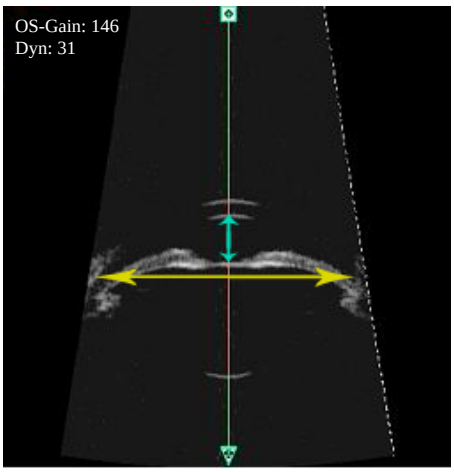

Fig. 1: Preoperative UBM image of Primary Angle-Closure Glaucoma (PACG) and co-existing cataract (the yellow arrow indicates anterior chamber diameter, the blue arrow indicate anterior chamber depth)

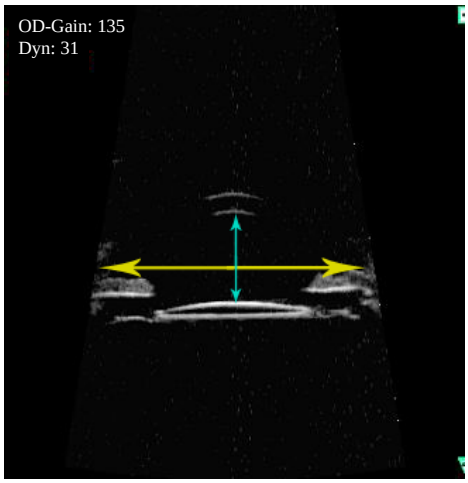

Fig. 2: UBM image of Primary Angle-Closure Glaucoma (PACG) and co-existing cataract after phacoemulsification and IOL implantation (the yellow arrow indicates anterior chamber diameter, the blue arrow indicate anterior chamber depth)

Statistic methods: Results of the study were analyzed by SPSS13.0 Software. Compare anterior chamber diameters and depths before and after surgery by t-test. Changes in diameters and depths of anterior chamber after surgery between test group and control group patients were analyzed by independent t-test when $p<0.01$ showed statistical significant different.

RESULTS AND DISCUSSION

Comparisons of the changes in anterior chamber diameter before and after surgery between test group and control group (Table 1). Mean values of anterior chamber diameter in glaucoma groups before and after surgery were less than that of control group and difference between them are statistically significant ($p<0.01$) testing the correlation coefficient of glaucoma group and control group, respectively ($C = 0.565$, $C = 0.767$) showed anterior chamber diameter was increased after surgery and there is a statistically significant difference ($p<0.01$).

Comparison of anterior chamber depth in patients with glaucoma combined age-related cataract and patients with pure age-related cataract, showed in Table 2. From the results, average value of pre-operational anterior chamber diameter in glaucoma group is less than that in control group and the difference is statistically significant ($p<0.01$) post-operational anterior chamber depth in these two groups was not statistically different. Testing the correlation coefficient of glaucoma group and control group ($C = 0.674$, $C = 0.687$), respectively showed anterior chamber diameter was increased after surgery and there is a statistically significant difference ($p<0.01$).

Primary closed-angle glaucoma is one of main types of glaucoma in China which is particularly common in elderly population. In patients aged >60 years, age-related cataract is often combined with glaucoma (Li, 2005). Since, glaucoma surgery may accelerate the development of cataract, ophthalmologist should choose combined cataract and glaucoma surgery or cataract surgery according to different patients' conditions. However, the pathophysiological mechanism of phacoemulsification with IOL implantation in treatment of glaucoma has not been determined yet (Altan *et al*., 2004). Here, by using the panorama UBM, researchers can obtain an overall view of pre and post-operative anterior chamber by swinging ultrasonic head and proceeded with the imaging technology which would offering great help for related research in future.

In addition, in cataract surgery some patients whose lens capsule membrane and ligaments cannot provide enough support with posterior capsule film or suspended ligament are not suitable for implanted IOL. Shin *et al*. (2001) reported that in these patients, trabeculectomy combined with sclera suture fixation intraocular lens implantation exhibited satisfied treating effects. However, this kind of surgical incision is relatively large which will do harm to conjunctiva. Especially in patients with slight angle closed or adhesion of the anterior chamber angle, anterior chamber lens will be an ideal option. Postoperative anterior chamber diameter in primary angle

Table 1: Comparison of anterior chamber diameter between co-existing CACG with cataract patients and age-related cataract patients (mm, $\bar{X}\pm S$, n = 40)

Time	Glaucoma	Control group	t-value
Preoperation	9.93±0.39	11.47±0.62	13.38
2 months post-operation	11.45±0.53	11.93±0.39	4.61

Table 2: Comparison of anterior chamber depth in patients with glaucoma combined age-related cataract and patients with pure age-related cataract (mm, $\bar{X}\pm S$, n = 40)

Time	Glaucoma group	Control group	t-value
Preoperation	2.09±0.27	3.04±0.28	15.87
2 months post-operation	3.74±0.26	3.76±0.30	0.27

closed glaucoma patients were measured precisely before and after lens excision which may contribute to predict anterior chamber diameter and choose of an optimum anterior chamber IOL.

In consideration of the anterior chamber IOL loops always locate in anterior chamber recess, the distance from two sides of the corneal meridian to anterior chamber angle fossae was deemed to be anterior chamber diameter (Zhang and Xin, 2006). This study showed that anterior chamber diameter and anterior chamber depth of patients with chronic angle-closure glaucoma are less than that in pure cataract patients significantly. Measurement results in this study of the preoperative and postoperative anterior chamber diameter in cataract surgery patients was similar to that in the study about 102 age-related cataract patients by Zhang *et al.* (2008). But for merger cases of glaucoma measurement result of preoperative obviously less than the control group. It could be because the merger with peripheral anterior chamber to glaucoma case abnormal structure.

Increasing of the anterior chamber diameter can be seen in both groups and that in glaucoma combined cataract patients is 0.48 mm less than in cataract group. While the two groups did not show significant differences in anterior chamber depth, indicating artificial lens were located in the same position. Therefore, the differences in anterior chamber diameter between the two groups may attribute to the chronic structural change of peripheral anterior chamber and anterior chamber angle in closed-angle glaucoma patients. Compared to simple age-related cataract, the structure of anterior chamber in cataract patients combined with chronic angle-closure glaucoma changes in a different manner after removal of the lens indicating that there is necessity to take different approaches to predict postoperative ACD in different patients. Even all the observations and measurements were done by the same operator, artificial errors still cannot be excluded. Researchers wish to modify the technology of measurement in later study.

CONCLUSION

In all, panoramic UBM is an accurate, noninvasive way to observe anterior chamber structure and it is of great value for preoperative and follow-up examination of age-related cataract patients. After phacoemulsification, anterior chamber is increased in diameter and deepened however these changes are not exactly the same variation as age-related cataract patients.

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