DOI:10.11817/j.issn.1672-7347.2014.04.002
http://xbyx.xysm.net/xbwk/fileup/PDF/201404333.pdf

Ocular biometric characteristics of acute and chronic primary angle-closure glaucoma in Chinese patients

HU Jie[1,2], JIANG Bing[1]

(1. Department of Ophthalmology, Second Xiangya Hospital, Central South University, Changsha 410011; 2. Department of Ophthalmology, Hunan Hospital of Traditional Chinese Medicine, Zhuzhou Hunan 412008, China)

ABSTRACT

Objective: To compare the ocular parameters of acute angle closure glaucoma (AACG) and chronic angle closure glaucoma (CACG).

Methods: Totally 106 patients with primary angle closure glaucoma were recruited: 58 patients with AACG and 48 with CACG. All patients were divided into 3 groups: AACG attack eyes group, AACG uninvolved fellow eyes group and CACG group and underwent the same ophthalmic examinations, comprising optometry, keratometry, and A-scan ultrasonography. The lens/axial length factor (LAF) and relative lens position (RLP) were calculated.

Results: The AACG attack eyes had a significant shallow anterior chamber depth, thick lens, short axial length and larger LAF. There tended to be a reduction in the percentage of LAF>0.20 in AACG attack eyes, CACG eyes and AACG uninvolved fellow eyes, though there were no statistically significant difference in all groups (P>0.05).

Conclusion: The eyes with AACG attack have a more crowded anterior chamber structure compared with uninvolved fellow eyes and eyes with CACG.

KEY WORDS ocular parameters; acute; chronic; primary angle closure glaucoma

急性和慢性原发性闭角型青光眼患者眼部生物学特征

胡婕[1,2]，江冰[1]

(1. 中南大学湘雅二医院眼科，长沙 410011；2. 湖南省直中医院眼科，湖南 株洲 412008)

[摘要]目的：探讨急性闭角型青光眼 (acute angle closure glaucoma，AACG) 和慢性闭角型青光眼 (chronic angle closure glaucoma，CACG) 间眼部参数的差异。**方法：**共收录 106 位原发性闭角型青光眼患者，其中包括 58 名 AACG

Date of reception：2013−08−01
Biography：HU Jie, master degree student, resident doctor, mainly engaged in the research of glaucoma and neuro-ophthalmology.
Corresponding author：JIANG Bing, Email: bingj82@126.com

患者和 48 名 CACG 患者，分为 AACG 发作眼、AACG 对侧眼和 CACG 患眼 3 组。对所有受试者进行验光、角膜曲率、A 超等眼科检查，并进一步计算晶体眼轴比和相对晶体位置。**结果：**AACG 发作眼具有前房浅、晶体厚、眼轴短、晶体眼轴比大等特点。晶体眼轴比 >0.2 的比例在 AACG 发作眼、CACG 患眼和 AACG 对侧眼中，呈逐渐递减趋势，但 3 组间差异无统计学意义 (P>0.05)。**结论：**对 AACG 对侧眼和 CACG 患眼而言，AACG 发作眼前房结构更为拥挤。

[关键词] 眼部参数；急性；慢性；原发性闭角型青光眼

In the global, glaucoma is a major cause of blindness and its incident number increasing year by year. It is estimated that there will be 80 million people with glaucoma and nearly 20.8 million are primary angle closure glaucoma (PACG). In Asia, the prevalence of PACG in all types of glaucoma is 87%, which has obvious regional difference[1-2]. Therefore, finding out its common feature is significant for early diagnosis and treatment.

Previous investigations have concluded that PACG tend towards have shallow anterior chamber depth, enhancive lens thickness and short axial length[3]. Regretfully, only few scholars have done further research to the biometric difference between acute angle closure glaucoma (AACG) and chronic angle closure glaucoma (CACG). Therefore, we can not be aware of these factors which lead to PACG to be differentiated into 2 different types (i.e. AACG and CACG). In this research, we evaluated the difference of ocular parameters between AACG and CACG.

1 Patients and methods

1.1 Patients

Patients underwent anti-glaucoma surgery for AACG and CACG were successively recruited from the second Xiangya Hospital of Central South University from February 2012 to June 2012.

AACG is defined as the presence of at least 3 clinical symptoms and signs as follows[4]: unilateral sharply impaired vision, eye pain, conjunctival injection, corneal edema, shallow anterior chamber depth, an unreactive middle pupil, homolateral headache, nausea, vomiting and obviously elevated intraocular pressure (IOP). To independently analyze the anatomical differences between the attack eyes and the fellow eyes, the former were partitioned into AACG attack eyes group, and the latter into uninvolved fellow eyes group.

The diagnosis of CACG is based on following performance[5]: gradually elevated IOP, peripheral iris anterior synechiae for more than 270 degrees, and with glaucomatous optic neuropathy and visual field defect. Additionally, patients with any ischemic injury signs resulted in acute ocular hypertension were excluded. To enhance data's independence, if both eyes of a CACG patient conform to the inclusion criteria, we would uniformly choose their right eyes into CACG group.

Participants were excluded if they had a history of ophthalmopathy or ocular trauma, and history of any intraocular surgery or laser peripheral iridotomy. Patients detected with secondary angle closure or plateau iris were also excluded.

1.2 Research contents

All recruiters underwent integrated ophthalmologic examinations, that included slit-lamp biomicroscope for examination of anterior segment (Model BQ900; Haag-Streit, Bern, Switzerland), Goldmann applanation tonometry (Haag-Streit, Koniz, Switzerland) for measurement of IOP, direct ophthalmoscope (YZ6E, 66 vision, Suzhou, China) for optic disc examination, ultrasound biomicroscopy (Aviso, Quantel Medical Inc., Marcoussis, France) to assess the degree of peripheral anterior synechiae, automated phoropter (CV-3000, Topcon Co, Tokyo, Japan), keratometry (KR-8100 Topcon Co, Tokyo, Japan), A-scan ultrasonography (Aviso, Quantel Medical Inc., Marcoussis, France) for measuring anterior chamber depth (ACD), lens thickness (LT) and axial length (AL). The lens thickness to axial length factor (LAF) was determined by formula[6] LT/AL. The relative lens position (RLP) was calculated by formula[7] (ACD+1/2 LT)/AL.

1.3 Statistical analysis

Data were presented as the mean±standard deviation ($\bar{x}$±s). The statistical analysis was performed with SPSS version 19.0 (SPSS, Inc., Chicago, IL). Differences in average values of test data in groups were analyzed using analysis of variance (ANOVA). Statistical analysis between the AACG attack eyes group and uninvolved fellow eyes group was carried out with paired sample T-test. Independent sample T-test was performed to contrast CACG group with the other two groups. A value of P<0.05 was considered statistically significant.

2 Results

2.1 Demographic characteristics

A total of 106 Chinese patients with PACG were recruited, consisting of 58 AACG patients (13 males and 45 females) and 48 CACG patients (22 males and 26 females).

Table 1 shows the demographic characteristics of selected eyes in all groups. With respect to age, there was no significant difference among the 3 groups. With regard to male-female ratio, it was the other way round. In AACG group, the male-female ratio is above 1:3, and the radio is close to 1:1 in CACG group. Moreover, there were no fundamental real distinctions found in refractive error in AACG attack eyes group, uninvolved fellow eyes group and CACG group.

Table 1 Demographic characteristics of research eyes

Characteristics	AACG attack eyes	AACG uninvolved fellow eyes	CACG eyes
Age/years	64.22 ± 9.00	64.22 ± 9.00	63.04 ± 11.33
Gender			
Male	13(22.4%)	13(22.4%)	22(45.8%)
Female	45(77.6%)	45(77.6%)	26(54.2%)
Male-female ratio	≈ 1:3	≈ 1:3	≈ 1:1

2.2 Ocular biometric parameters

The results of ocular biometric parameters were shown in Table 2. No significant difference was noted for Keratometry (comprising horizontal, vertical and average data).

In AACG attack eyes, the ACD was significantly shallow when compared with the other 2 groups separately ($P<0.05$). But there was no significant difference of ACD between uninvolved fellow eyes and CACG eyes ($P>0.05$).

Although AACG attack eyes and uninvolved fellow eyes were belong to the same patients, the former had significant thicker lens than the latter ($P<0.05$). There was no significant difference in LT between all the other groups ($P>0.05$).

The AL had no significant difference in all groups, except for AACG attack eyes had obvious shorter AL than uninvolved fellow eyes ($P<0.05$).

The LAF was significantly different between AACG attack eyes group and the other 2 groups ($P<0.05$). The LAF of AACG attack eyes (0.22±0.02), which was significantly larger than the remaining 2 groups. Additionally, no significant difference of LAF was found in uninvolved fellow eyes and CACG eyes. Figure 1 showed that there tended to be a reduction in the percentage of LAF>0.20 in AACG attack eyes, CACG eyes and uninvolved fellow eyes.

There was no significant difference of the RLP in all groups.

The eyes with AACG attack have a shallower ACD, thicker lens, shorter AL and larger LAF compared with the uninvolved fellow eyes. Moreover, these ocular biometric parameters in uninvolved fellow eyes were similar to those in CACG eyes. There tended to be an increment in the ACD and AL and an reduction in the LT, LAF and RLP in eyes with AACG attack, CACG eyes and uninvolved AACG fellow eyes.

Table 2 Comparison of ocular biometric parameters among the 3 groups

Parameters	AACG attack eyes	AACG uninvolved fellow eyes	CACG eyes
Refractive error/D	−0.13 ± 1.69	−0.46 ± 2.97	−0.51 ± 2.90
Keratometry/D			
Horizontal	44.42 ± 1.98	44.09 ± 2.13	43.87 ± 1.68
Vertical	44.57 ± 1.87	44.51 ± 2.06	44.31 ± 1.63
Average	44.63 ± 2.04	44.29 ± 1.99	44.08 ± 1.48
Anterior chamber depth/mm	$2.34 \pm 0.16^{*\#}$	2.51 ± 0.22	2.51 ± 0.20
Lens thickness/mm	$4.85 \pm 0.39^{*}$	4.65 ± 0.54	4.68 ± 0.53
Axial length/mm	$22.28 \pm 1.49^{*}$	22.86 ± 1.26	22.81 ± 1.27
LAF	$0.22 \pm 0.02^{*\#}$	0.20 ± 0.02	0.21 ± 0.02
RLP	0.21 ± 0.01	0.21 ± 0.02	0.21 ± 0.02

$^{*}P<0.05$ vs AACG uninvolved fellow eyes; $^{\#}P<0.05$ vs CACG eyes; LAF: lens thickness to axial length factor; RLP: relative lens position

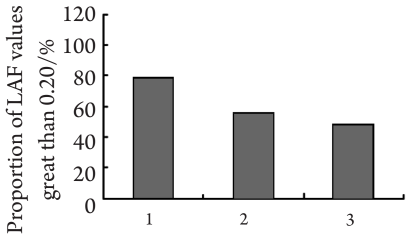

Figure 1 Proportion of LAF values greater than 0.20

1: AACG attack eyes; 2: AACG uninvolved fellow eyes; 3: CACG eyes

3 Discussion

With the development of the ultrasonic technology, ocular biometric parameters can be detected accurately such as ACD, LT and AL. In recent decades, a great quantities of study were performed to compare eyes with PACG eyes with normal eyes. Now it is generally known that eyes with PACG have a shallower ACD, a thicker lens[8] and a shorter AL[6]. Whereas, a few studies were carried out about the differences between AACG eyes and CACG eyes. Marchini et al[9] found a gradual progressive trend of variation in anatomic characteristics, as ACD, LT, LAF and RLP, the first was normal eyes, and then was eyes with CACG, and finally was eyes with AACG. On the contrary, Sihota et al[10] found that there was no significant difference in RLP between patients with PACG and their family members. They concluded that PACG may resulted from narrow ACD, thick LT and short AL.

Our study showed that there were significant differences in certain ocular biometric parameters between eyes with AACG and eyes with CACG. However, differences in the age, refractive error and keratometry between eyes with AACG and CACG were not significant. This could be due to these elements have little effect on the development of PACG. In our study, the differences of ACD in eyes with AACG and CACG were compliant with the previous conclusion of other investigators. ACD in AACG attack eyes were significantly shallower than that in uninvolved fellow eyes and CACG eyes. But there was no difference between uninvolved fellow eyes and CACG eyes. The causal relationship between the shallower ACD and an acute AACG attack was unclear. Is the shallower ACD increased the risk of an acute AACG attack? Or in contrast an acute AACG attack made ACD become shallower?

In the past, conclusions about LT and AL in all types of PACG were not consistent. In our research, although LT of uninvolved fellows eyes and CACG eyes were smaller than that of AACG attack eyes, significant difference was only existed between AACG attack eyes and uninvolved fellow eyes. The situation is mirrored in AL, that only the difference between AACG attack eyes and uninvolved fellow eyes was significant. This makes us think about if there is any other influences impact the development of subtype in PACG.

Qi[6]proposed LAF could be counted as a powerful indicatrix for evaluating biometric characteristic of PACG. And he considered LAF of 0.20 was ideal boundary between eyes with PACG and normal eyes. Marchini et al[9] found significant difference in eyes with PACG and normal eyes. In our study, LAF in AACG attack eyes were significant greater relative to uninvolved fellow eyes and CACG eyes . Figure 1 showed there tended to be a reduction in the percentage of LAF>0.20, in AACG attack eyes, CACG eyes and uninvolved fellow eyes. All of these prompt us that severe asymmetry of the eye structure will increase the risk of an AACG attack.

RLP is a controversial index for anatomical assessment of eye with PACG. Sihota et al[11] found that AACG attack eyes had a significant smaller RLP than eyes with CACG or normal eyes, what was meaned that the lenses location of the former was more anterior. On the contrast, Sihota et al[10] found that there were no statistical differences in RLP between PACG patients and their family dependents. In our research, RLP in all groups had no significant differences. One potential explanation for the circumstance might be that RLP depends on the general changing trend of ACD, LT and AL.

We presume that a shallower ACD, a thicker lens and a shorter AL, which make LAF become larger, could be result in the diversity of the subtypes of PACG and even maybe determine which eye is more likely to undergo AACG attack. Although using anatomical differences in individuals to explain the pathogenesis of PACG is oversimplified and unpractical, to some extent it can help us to find out clues about how PACG occurs. Except for the traditional mechanisms of PACG, pupillary block, choroidal expansion were proposed recently as a possible mechanism for PACG. In small eyes, the forward lens movement and greater iris convexity caused by choroidal expansion will increase the risk of PACG[12]. Nongpiur et al[13] found a new lens parameters-lens vault (LV) by anterior-segment optical coherence tomography(AS OCT), which is the vertical distance between the anterior peak of the lens and the line connect the two scleral spurs. And eyes with angle closure have greater LV than normal eyes, that means a more crowded anterior chamber structure in eyes with angle closure.

Unlike A-scan ultrasonography, it is impossible for AS OCT to popularization application for its exorbitant price. To illustrate thoroughly the pathogenesis led to the classification of PACG, larger sample size and more scientific and comprehensive researches are demanded.

References

1. Cook C, Foster P. Epidemiology of glaucoma: what's new[J]. Can J Ophthalmol, 2012, 47(3): 223-226.
2. Quigley HA, Broman AT. The number of people with glaucoma worldwide in 2010 and 2020[J]. Br J Ophthalmol, 2006, 90(3): 262-267.
3. Aung T, Nolan WP, Machin D, et al. Anterior chamber depth and the risk of primary angle closure in 2 East Asianpopulations[J]. Arch Ophthalmol, 2005, 123(4): 527-532.
4. Lee KY, Rensch F, Aung T, et al. Peripapillary atrophy after acute primary angle closure[J]. Br J Ophthalmol, 2007, 91(8): 1059-1061.
5. Foster PJ, Buhrmann R, Quigley HA, et al. The definition and classification of glaucoma in prevalence surveys[J]. Br J Ophthalmol, 2002, 86(2): 238-242.
6. Qi Y. Ultrasonic evaluation of the lens thickness to axial length factor in primaryclosure angle glaucoma[J]. Yan Ke Xue Bao, 1993, 9(1): 12-14.
7. Lowe RF. Aetiology of the anatomical basis for primary angle-closure glaucoma. Biometricalcomparisons between normal eyes and eyes with primary angle-closure glaucoma[J]. Br J Ophthalmol, 1970, 54(3): 161-169.
8. Saxena S, Agrawal PK, Pratap VB, et al. Anterior chamber depth and lens thickness in primary angle-closure glaucoma: acase-control study[J]. Indian J Ophthalmol, 1993, 41(2): 71-73.
9. Marchini G, Pagliarusco A, Toscano A, et al. Ultrasound biomicroscopic and conventional ultrasonographic study of ocular dimensions in primary angle-closure glaucoma[J]. Ophthalmology, 1998, 105(11): 2091-2098.
10. Sihota R, Ghate D, Mohan S, et al. Study of biometric parameters in family members of primary angle closure glaucomapatients[J]. Eye (Lond), 2008, 22(4): 521-527.
11. Sihota R, Lakshmaiah NC, Agarwal HC, et al. Ocular parameters in the subgroups of angle closure glaucoma[J]. Clin Experiment Ophthalmol, 2000, 28(4): 253-258.
12. Quigley HA, Friedman DS, Congdon NG. Possible mechanisms of primary angle-closure and malignant glaucoma[J]. J Glaucoma, 2003, 12(2): 167-180.
13. Nongpiur ME, He M, Amerasinghe N, et al. Lens vault, thickness, and position in Chinese subjects with angle closure[J]. Ophthalmology, 2011, 118(3): 474-479.

本文引用： 胡婕 , 江冰 . 急性和慢性原发性闭角型青光眼患者眼部生物学特征 [J]. 中南大学学报 : 医学版 , 2014, 39(4): 333-337. DOI:10.11817/j.issn.1672-7347.2014.04.002

Cite this article as: HU Jie, JIANG Bing. Ocular biometric characteristics of acute and chronic primary angle-closure glaucoma in Chinese patients[J]. Journal of Central South University. Medical Science, 2014, 39(4): 333-337. DOI:10.11817/j.issn.1672-7347.2014.04.002

(Edited by GUO Zheng)