IJMS
Vol 34, No 4, December 2009

Original Article

The Biometric Values of Affected and Fellow Eyes in Patients with Acute Attack of Primary Angle Closure

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Abstract

Background: It has been estimated that 67 million people worldwide are affected with a primary glaucoma and that one-third have primary angle closure glaucoma. We aimed to determine the biometric differences between the eyes of patients with acute attack of primary angle closure and their non-involved fellow eyes.

Methods: Twenty eight patients with acute attack of primary angle closure were recruited in this prospective study. Three weeks after laser iridotomy and resolution of corneal edema, all patients had a complete ocular examination including slit lamp biomicroscopy, pachymetry, keratometry, and ocular biometry. The following A-scan parameters were measured: anterior chamber depth, lens thickness, axial length, lens– axial length factor, relative lens position, and corrected anterior chamber depth.

Results: There were 22 (78.5%) women and six (21.5%) men with mean age of 52.82±9.25 years. There were no statistically significant differences in the biometric figures between the affected and fellow eyes [anterior chamber depth (P=0.4), lens thickness (P=0.4), axial length (P=0.7), lens-axial length factor (P=0.6), relative lens position (P=0.7), and corrected anterior chamber depth (P=0.8)]. The mean ± standard deviation of central corneal thickness in the affected and fellow eyes were 560.12±41.93 and 557.727±18.53, respectively (P=0.806). There was no statistically significant difference between the both eyes in the mean keratometric diopters in the affected and in the fellow eyes (45.05±2.02 *v* 44.91±1.73; P=0.78).

Conclusion: The present study did not reveal any statistically significant differences regarding the ocular biometric parameters between the affected and fellow eyes in patients with acute primary angle closure. The biometric parameters were similar between male and female patients as well.
Iran J Med Sci 2009; 34(4): 246-250.

Keywords ● Angle closure glaucoma ● biometry ● ultrasonography ● ultrasonography

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Received: 24 May 2009
Revised: 13 August 2009
Accepted: 10 September 2009

Introduction

It has been estimated that 67 million people worldwide are affected with a primary glaucoma and that one-third have primary angle closure glaucoma. Additionally, it is

estimated that the number of people with glaucoma will increase from 60.5 million in 2010 to 79.6 million by 2020, and of them, 26% will have angle-closure glaucoma.[1] Primary angle closure glaucoma is classified as acute (APAC), sub acute, and chronic types.[2] Previous research have shown certain biometric characteristics in the eyes affected by primary angle-closure, such as a shallower anterior chamber, thicker lens, more anterior lens position, and shorter axial length.[3-9] The most important biometric feature in the angle closure glaucoma is a shallow anterior chamber.[2]

Factors that trigger an episode of APAC are unknown, and it would be of interest to know why APAC occurs in certain eyes but not in their fellow eyes. Several studies have shown a difference in biometric parameters of the affected eyes compared with the fellow non-involved eyes.[7,10,11] In contrast, other studies revealed no statistically significant difference in the biometric values.[12-14] Moreover, He and colleagues,[15] proved a difference in the biomechanical properties of iris in the subtypes of angle closure glaucoma that might play a role in the development of APAC attacks. The present study was conducted to determine any possible differences between the biometric parameters of the affected and fellow eyes in patients with APAC.

Patients and Methods

This prospective study was done on 28 patients who referred to the Emergency Department of a university affiliated hospital in Shiraz (south of Iran) from February 2007 to March 2009 and met the criteria for diagnosis of APAC. Informed consent was obtained from all participants. The diagnosis of APAC was based on the classic symptoms of acute onset of unilateral eye pain, blurred vision, headache, nausea, vomiting, halos around lights, and ophthalmologic findings of elevated intraocular pressure [intraocular pressure (IOP)≥ 35 mm Hg], accompanied by red eye, corneal edema, a shallow anterior chamber, and a no reactive mid-dilated pupil but no glaucomatous optic neuropathy.[7] The exclusion criteria were; previous laser peripheral iridotomy or laser peripheral iridoplasty, previous ocular or glaucoma surgery, and secondary angle closure glaucoma (neovascularization, uveitis). All the patients underwent laser iridotomy in both eyes (the fellow eyes in all patients had angles prone to occlusion) after reduction of IOP by mannitol and antiglaucoma medications and resolution of corneal edema. Three weeks after the first attack, the patients had an ophthalmologic examination including slit lamp biomicroscopy, IOP measurement, gonioscopy using a Sussman goniolens, and funduscopy. Patients with a history of ocular trauma, intraocular surgery, any intraocular disorder except for cataract, and secondary angle-closure glaucoma were excluded.

All pachymetries were performed on the central cornea with an ultrasound pachymeter (Paxis, Biovision Inc, Clermont-Ferrand, France) by an experienced nurse. Ten measurements were taken in the center of the cornea and the lowest reading was chosen as the central corneal thickness. The lowest reading is the most likely one to reflect a perpendicular placement of the pachymeter probe and, therefore, the most accurate measurement.[16] Keratometries were measured using an auto-keratorefractometer (Auto Kerato-Refractometer KR-8900, Topcon Co, Tokyo, Japan).

Contact ultrasound biometry (no immersion) was performed on each eye using a Nidek Echoscan US 800 instrument (Echoscan US-800; Nidek Co, Tokyo, Japan). Topical anesthetic drop (0.5% tetracaine) was instilled in each eye before taking Echoscan measurements. The measurements were performed on the right eye followed by the left eye. In order to neutralize the effect of accommodation on the measured lens thickness, all patients were asked to look with their other eyes at a target located six meters from them. Six measurements were taken per patient by a nurse experienced in ocular biometry. The standard deviation for the axial length, anterior chamber depth, lens thickness, or vitreous chamber depth was within 0.12 mm.[17] The following values were recorded for each eye: (1) anterior chamber depth; (2) lens thickness; (3) axial length; (4) lens/axial length factor as the lens thickness to axial length ratio multiplied by 10; (5) relative lens position as the relative position of the center of the lens measured by anterior chamber depth +1/2 *lens* thickness)/axial length multiplied by 10,[2] and (6) corrected anterior chamber depth (the depth minus central corneal thickness).

The Independent sample *t* test was used to determine the differences between the means of the affected and fellow eyes. A level < 0.05 was considered statistically significant. In the presentation of the results, mean values are reported with standard deviation (mean ± SD).

Results

A total of 28 patients with APAC were recruited. There were 22 (78.5%) women and six (21.5%) men. The mean age of the participants

was 52.82±9.25 years. All biometric values of the affected and fellow eyes are shown in table 1. The mean ± SD of central corneal thickness in the affected and fellow eyes were 560.12±41.93µ and 557.727±18.53µ, respectively (P=0.81). There was no statistically significant difference between the both eyes in mean *keratometric* diopters in the affected and the fellow eyes (45.05±2.02 *v* 44.91±1.73; P=0.78).

Discussion

Racial differences in the prevalence of primary angle closure glaucoma have long been recognized, although the mechanisms underlying these differences are not well understood. There are several reports concerning the characteristic ocular biometry in patients with angle closure glaucoma.[2,6,7,18-21] Eyes with primary angle closure have significant anatomic differences with normal eyes. The most significant clinical hallmarks of an eye with closed angle are the shallow anterior chamber and narrow iridocorneal angle. The mean anterior chamber depth in eyes with primary angle closure is approximately 1.8 mm, which is 1 mm shorter than that of normal eyes. Increased lens thickness accounts for 0.35 mm of this and a more forward lens position for remaining 0.65 mm.[22] The threshold value for anterior chamber depth for occurrence of angle closure glaucoma is 2.5 mm.[21,23] In fact, angle closure becomes a rarity when anterior chamber depth exceeds 2.5 mm. The mean lens thickness in our study was 4.78 mm which was less than the reported lens thickness in APAC (4.9-5.23).[5,24] According to the three previous studies on the biometric figures of patients with APAC, it is obvious that the only consistent character among them was shallower anterior chamber depth in the affected eyes (table 2).[7,10,11] Recently, He and colleagues showed significantly higher amounts of collagen type-1 in the iris stroma of patients with APAC. The authors concluded that more collagen type-1 equates less iris elasticity and stiffer irises predisposes these eyes to APAC attack.[15] Clearly, smaller ocular biometry parameters are a risk factor for angle closure glaucoma. However, the results of He's,[15] study has raised a question to the value of these biometric characteristics. There are gross variations in the parameters reported, some probably related to racial differences, and some to the different methods used for measurement of ocular parameters. The values for all parameters are not available in each

Table 1: Conventional A-scan biometric parameters in the affected and fellow eyes of patients with acute primary angle closure (mean ± standard deviation).

Biometric Parameter	Affected Eye	Fellow Eye	Significance (p value)
Intraocular lens power (diopter)	24.91±4.54	24.47±4.23	0.720
Lens thickness (mm)	4.84±0.31	4.91±0.33	0.408
Relative lens position	2.30±0.21	2.32±0.22	0.752
Lens/Axial length factor	2.22±0.17	2.25±0.22	0.673
Axial length (mm)	21.80±1.43	21.94±1.31	0.729
Anterior chamber depth (mm)	2.57±0.21	2.62±0.19	0.429
Corrected anterior chamber depth (mm)	2.02±0.22	2.03±0.18	0.856
Vitreous chamber depth (mm)	14.43±1.41	14.41±1.42	0.961

Table 2: Comparison of measured ocular parameters in eyes with acute primary angle closure in the present study and the earlier reports.

	Lan et al.[7] (33 patients)		Lim et al.[11] (73 patients)		Merula et al.[10] (28 patients)		Current study (28 patients)	
	Involved eyes	Fellow eyes	Involved eyes	Fellow eyes	Involved eyes	Fellow eyes	Involved eyes	Fellow eyes
Anterior chamber depth (mm)	2.25± 0.20	2.41± 0.21	2.11± 0.35	2.18± 0.23	2.43 ± 0.28	2.51 ± 0.29	2.57± 0.21	2.62± 0.19
Lens thickness (mm)	5.10± 0.33	4.96± 0.42	5.01± 0.69	5.13± 0.53	4.85 ± 0.32	4.85 ± 0.36	4.84± 0.31	4.91± 0.33
Axial length (mm)	22.39± 0.64	22.39± 0.62	21.86± 0.92	21.97± 0.86	21.68 ± 0.96	21.82± 0.92	21.80± 1.43	21.94± 1.31
Lens axial length factor	2.28± 0.16	2.23± 0.19	--	--	2.24 ± 0.16	2.23± 0.18	2.22± 0.17	2.25± 0.22
Relative lens position	2.15± 0.11	2.19± 0.13	2.1± 0.3	2.2± 0.2	--	--	2.30± 0.21	2.32± 0.22
central corneal pachymetry (µ)	--	--	--	--	534.46± 34.15	533.18± 31.41	560.12± 41.93	557.72± 18.53
Mean keratometry (D)	--	--	--	--	45.21± 1.96	44.92±1. 86	45.05± 2.02	44.91± 1.73
Sex(M/F)	11/22	11/22	27/46	27/46	--	--	6/22	6/22
Mean age	65.9±8.5	65.9±8.5	61.0±10.9	61.0±10.9	59.6	59.6	52.82±9.25	52.82±9.25

study, yet the interrelated variations among the anatomical features in all groups are clearly seen. Moreover, the mechanisms underlying these differences are not completely clarified. Congdon and co-workers,[13] have not found a shallower anterior chamber depth in Chinese patients with APAC, who are a population with high rate of angle closure glaucoma (ACG). Wojciechowski and others suggested that a more rapid shallowing of anterior chamber in Chinese and Eskimos is a contributing factor in induction of glaucoma.[25] The results of our study is comparable with Alsbirk,[12] who found no difference in the anterior chamber depth in the various forms of angle closure studied. Additionally, Lowe,[4,22] failed to demonstrate evidence of any significant differences between the various clinical types of ACG either in conventional biometric parameters or anterior lens curvature. He postulated, however, that the configuration and anterior rotation of the ciliary body may play a role in the chronic form of ACG. Gohdo and colleagues,[14] in an ultrasound biomicroscopic evaluation of anterior segment have shown that the ciliary bodies in the narrow angle eyes are thinner than normal control eyes. Additionally, the thickness of the ciliary body was related to lens thickness and anterior chamber depth. They admitted that the thinning of the ciliary body might be one of the important factors associated with anterior location of lens, increased lens thickness, and the decreased anterior chamber depth.[14] Kumar and co-workers,[26] confirmed the presence of uveal effusion in patients with angle closure glaucoma which is regarded as one of the possible mechanisms in induction of angle closure. Considering these factors in the occurrence of angle closure, drawing a clear conclusion seems impossible and the biometric characters cannot be the sole possible inductive factors.

The limitations of the present study must be acknowledged. The sample population examined was small, consisting of only 28 eligible patients. Thus, our conclusions must be provisional. With respect to the decline in the prevalence of APAC, performing a study on a larger group of patients seems impractical. There are several reasons for this phenomenon including performing prophylactic iridotomy in patients with shallow anterior chamber and occludable iridocorneal angle in gonioscopy and on-time cataract surgery which decreases the proportion of people with thick lenses in the population. Moreover, there are reports showing similar biometric characteristics among people with different races compatible with the results of our study.[13,25]

In limited sample size used in the present study, no statistically significant differences were observed between the biometric parameters of the affected and fellow eyes of patients with APAC. Further studies on larger sample size with ultrasound biomicroscopic evaluation of ciliary body and anterior segment and histochemical evaluation of iris may be necessary to determine the possible mechanisms of acute attack in patients with angles prone to occlusion.

Conflict of Interest: None declared

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