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High Prevalence of Narrow Angles among Chinese-American Glaucoma and Glaucoma Suspect Patients

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Abstract

Purpose—To evaluate the prevalence of gonioscopically narrow angles in a Chinese-American population with glaucoma or glaucoma suspicion.

Patients and Methods—Charts from all Chinese-American patients seen in a comprehensive ophthalmology clinic in the Chinatown district of San Francisco in 2002 were reviewed. One eye from each patient with glaucoma or glaucoma suspicion that met inclusion criteria was included (n=108). Data was collected for gender, age, race (self-declared), refraction (spherical equivalent), intraocular pressure (IOP), gonioscopy and vertical cup-to-disk ratio (CDR).

Results—Sixty percent (n=65) of Chinese-American eyes with glaucoma or glaucoma suspicion had gonioscopically narrow angles (Shaffer grade ≤ 2 in three or more quadrants). Those with narrow angles were significantly older ($P=0.004$) than their open angle counterparts, but the two groups did not differ in terms of gender, refraction, IOP or CDR (all, $P \geq 0.071$). In a multivariate model including age, gender and refraction as predictors of angle grade (open or narrow), only age was a significant predictor of angle grade ($P=0.004$).

Conclusions—A large proportion of Chinese-Americans in our study population with glaucoma or glaucoma suspicion had gonioscopically narrow angles. In multivariate analysis, patients with narrow angles were older than those with open angles but did not differ from them in terms of gender or refraction. Continued evaluation of angle closure glaucoma risk among Chinese-Americans is needed.

Introduction

Glaucoma is the leading cause of bilateral irreversible blindness worldwide, with over 60 million people affected. Primary open angle glaucoma (POAG) is likely responsible for three quarters of glaucoma and primary angle closure glaucoma (PACG) most of the remainder. However, the prevalence of POAG and PACG seem to vary widely among populations.¹⁻³ One of the most predictive predisposing factors to the development of occludable angles, which often leads to PACG, is an anterior chamber drainage angle judged to be narrow.⁴ Consequently, many studies have evaluated the prevalence of narrow angles or primary angle closure in various populations.⁴⁻¹⁴

A particularly high prevalence of narrow or occludable angles or angle closure has been identified in several East Asian populations including those from Vietnam⁶, Thailand⁷, Burma⁸, Mongolia^{4, 13}, Singapore^{12, 13} and China^{14, 15}. A large population-based study in the

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Guangzhou province of southern China estimated the prevalence of gonioscopically narrow angles in subjects over the age of 50 years to be 36.9%.¹⁴ In Singaporean Chinese, the prevalence of occludable angles using stricter criteria was found to be 10.6% in this age group.¹² This prevalence of narrow angles was estimated to be 14% in Thailand⁷ and 5.7% in Burmese subjects aged 40 years or older⁸. These proportions are much higher than those reported for Caucasian-Americans, whose total prevalence of narrow angles has been estimated at 3.8%.¹⁶

Despite the high prevalence and thorough characterization of glaucoma in East Asia, there exists limited data in Asian-American populations. One investigation of Vietnamese-Americans found the prevalence of narrow angles to be 47.8% in those aged 55 years or older⁶, but very little data exists for other East-Asian American populations.

According to the year 2000 US Census, Chinese-Americans comprise the largest Asian sub-population in the US.¹⁷ Glaucoma in this group remains understudied. In the present report, we evaluated the prevalence of narrow angles in a Chinese-American clinic population at risk for glaucoma-related vision loss, including those with glaucoma or glaucoma suspicion.

Methods

Approval was obtained for retrospective chart review from the Committee on Human Research at the University of California, San Francisco. Chart review was performed in a comprehensive ophthalmology clinic (SYK) located in the predominantly Chinese-American Chinatown district of San Francisco. Charts from all patients seen in 2002 were reviewed in order to identify all patients who were self-declared Chinese-American and had glaucoma or glaucoma suspicion in at least one eye (n=111). If available, right eyes were used for analysis. Left eyes that met inclusion criteria were included only when that patient's right eye did not meet those criteria. Patients were excluded if they were younger than 18 years old, and individual eyes were excluded if they had undergone intraocular surgery. One patient with glaucoma suspicion was younger than 18 years and two others had undergone phacoemulsification with intraocular lens placement in both eyes. After excluding these patients, 108 eyes (99 right and 9 left) remained for analysis.

Several comprehensive and specialist ophthalmologists serve the Chinatown region of San Francisco. This area is also located geographically near several hospitals which provide ophthalmic care, including Kaiser Permanente Medical Center San Francisco and the University of California - San Francisco. Many Chinese-American patients in this population regularly use alternative medicine in place of, or in combination with traditional ophthalmic treatment, and may not present to an ophthalmologist until they manifest symptoms of advanced disease.

It is also typical for patients in this population to visit several specialist physicians without returning. Consequently many charts reviewed were from patients who were seen only once, and did not have the appropriate diagnostic testing (optic nerve imaging, visual fields testing, etc.) to diagnose glaucoma according to the American Academy of Ophthalmology's Preferred Practice Patterns guidelines.¹⁸ As a result, it was often difficult to determine which patients indeed had glaucoma or were merely suspects. Therefore a single, broad grouping of "glaucoma or glaucoma suspicion" was created for analysis.

For study purposes, an eye was considered to have "glaucoma or glaucoma suspicion" if it met one or both of the following two criteria:

1. A history of an intraocular pressure (IOP) recording of >21 mmHg by Goldmann applanation tonometry.

2. A cup-to-disk ratio of ≥ 0.5 with no other discernable cause, including neurological or congenital defects.

Data was collected retrospectively for gender, age, race (self-declared), refraction (spherical equivalent), IOP, gonioscopy and vertical cup-to-disk ratio (CDR) for every patient's most recent visit in 2002. IOP was measured using Goldmann applanation, and gonioscopy was performed using a Zeiss-style gonioscopic lens. Angles were graded based on the Shaffer method in all four quadrants (superior, nasal, temporal, and inferior). In the charts, angle quadrants open to 30° or more on gonioscopy were routinely recorded as the single measurement "3-4", which has been subsequently adopted by this report.

The anterior chamber angles of all eyes included in this study were found to have a single gonioscopic grade across three or all of their quadrants. This gonioscopic grade was assigned to each eye for analysis. Eyes were then divided into two groups based on their angle grade. Eyes with "open" angles were defined as those with Shaffer grades of 3-4 in three or all quadrants, and eyes with "narrow" angles were defined as those with Shaffer grades of 2 or less in three or all quadrants.

Normality of the data was evaluated using the skewness and kurtosis values of the distribution and the Kolmogorov-Smirnov test. Several variables, including age and refraction, were found not to have normal distributions by these methods. Therefore, non-parametric tests were used for statistical analyses. Comparisons between narrow and open angle groups were performed using the Mann-Whitney U Test and correlations between continuous variables were performed using the Spearman's rank correlation coefficient. The comparison of gender distribution between angle grades was made using the Kendall tau-b correlation coefficient. A multivariate model was also created using binary logistic regression to evaluate the isolated effects of age, gender and refraction as predictors of angle grade (narrow or open). All statistical analyses were performed using SPSS version 11.5 for Windows. P-values less than 0.05 were considered significant.

Results

One hundred and eight eyes from 108 patients with glaucoma or glaucoma suspicion who had been seen in 2002 were included for analysis. Gonioscopy data, CDR, IOP, and manifest refractions were available for all subjects. Overall, 65 patients (60.2%) had gonioscopically narrow angles.

Sixty three patients were women (58.3%) and 45 (41.7%) were men. The mean ages were 69 ± 11 years (range 18-87 years) for women and 66 ± 14 years (range 23-82 years) for men. Men and women in our population did not significantly differ in terms of age, refraction, IOP or CDR (all, $P \geq 0.36$). The distribution of angle grades was significantly different between men and women ($P=0.013$) (Table 1). The distribution of angle grades by age is outlined in Figure 1.

The mean refractive error was -0.04 ± 2.8 diopters (D) (range -10.5 to +8.5 D) overall and -0.70 ± 3.45 D for those with grade 3-4 angles, -0.48 ± 2.11 D for those with grade 2 angles, $+0.89 \pm 1.49$ D for those with grade 1 angles, and $+0.65 \pm 1.99$ D for those with grade 0 or slit angles. The mean CDR across all patients was 0.50 ± 0.21 (range 0.2-0.9) and the mean IOP was 21.9 ± 3.9 mmHg (range 12-36 mmHg) overall.

The Spearman's rank correlation coefficient for the relationship between age and CDR closely approached significance ($r=0.20$, $P=0.05$) with CDR increasing with advancing age. Age was not significantly correlated with IOP or refraction (all, $P \geq 0.14$).

Patients from our population with narrow angles were found to be significantly older ($P=0.004$) than their open angle counterparts. The mean refraction of those with narrow angles was more hyperopic than those with open angles, but this relationship did not reach significance ($P=0.071$). The two groups did not differ significantly in terms of gender, IOP or CDR (all, $P\geq 0.22$) (Table 2).

In our multivariate model with age, gender and refraction as predictors of angle grade (narrow or open), age was found to be a significant predictor of angle grade ($P=0.004$), while gender and refraction were not (all, $P\geq 0.27$).

Discussion

The prevalence of POAG in Caucasian-Americans has been reported to be between 0.28% and 2.2%^{16, 19} whereas the prevalence of PACG has been documented as 0.09% among Caucasian-Americans over 40 years of age²⁰. Alaskan Eskimos in this age range, on the other hand, have a reported PACG prevalence of 2.65%, almost 30 times higher than that of Caucasian-Americans.²¹ In addition, population-based studies performed in China, Thailand, Taiwan, India, the Philippines, Singapore and Japan have found higher prevalence statistics for PACG than those reported in Caucasians.^{7, 10, 15, 22, 23}

An anatomically narrow anterior chamber angle may be the most predictive factor in the development of occludable angles⁴, and perhaps PACG, however there exists limited data on the prevalence of narrow angles in East Asian-American populations. A high prevalence of narrow angles has been reported in the Vietnamese-American population⁶, but little data exists concerning Chinese-Americans.

Our results indicate that a large proportion (60.2%) of our Chinese-American population with glaucoma or glaucoma suspicion have gonioscopically narrow angles. These findings seem to agree with population-based data from Asia, which suggest a high prevalence of narrow angles in both the mainland¹⁴ and Singaporean Chinese¹² populations (36.9% and 10.6% among those ≥ 50 years, respectively). Although the findings of the present study are not population-based, the relatively high proportion of narrow angles in our glaucoma and suspect populations may suggest that Chinese-Americans may have a similarly high prevalence of narrow angles compared to mainland or Singaporean Chinese.

The early identification of narrow anterior chamber angles is important, as primary angle closure glaucoma is a leading cause of irreversible blindness in many populations, including mainland Chinese.¹⁵ In current ophthalmologic practice, a laser peripheral iridotomy (LPI) is the routine recommended treatment for most patients with narrow angles. The treatment has been shown to increase the size and depth of the anterior chamber and open the angle in most patients with narrow angles.^{24, 25}

The direct relationship between anterior chamber angle narrowing and both shortened axial length and increased lens thickness have been discussed in the literature at length.^{14, 26-29} Similarly, narrow anterior chamber angles have consistently been shown to correlate strongly with age and female gender both in mainland Chinese^{14, 28, 30}, and in other ethnic groups^{9, 20, 27}. Our population of Chinese-American glaucoma and suspect patients differs from those previously studied. Patients in our population with narrow angles were found to be significantly older, but not more hyperopic or more likely to be female compared to their open angle counterparts. Age was also found to be a significant predictor of narrow angles in our multivariate model, while gender and refraction were not.

If Chinese-Americans are phenotypically similar to mainland or Singaporean Chinese, it is reasonable to extrapolate that they are likely to have an increased prevalence of narrow angles

and risk for PACG compared to many other ethnically different American populations. Although not population-based, our study targets angle status in those patients most likely to suffer glaucoma-related vision loss, namely those with glaucoma or glaucoma suspicion. Our data is also derived from all patients who were seen by a comprehensive ophthalmologist over a defined time period, which limits the study's potential for selection or referral bias.

The fact that our study population includes only Chinese-American patients with glaucoma or glaucoma suspicion also serves as a limitation, since there are no comparison populations within the same clinic. The study subjects are not population-based, and therefore should not be expected to represent the Chinese-American population at large. A cross-sectional, population-based analysis is a logical next step to evaluate the anterior chamber angle characteristics of this large, yet understudied population.

Our data suggests that a significant portion of Chinese-American patients with glaucoma or suspicion are at high risk for having narrow anterior chamber angles. This study should serve as a starting point for the continued evaluation of angle-closure glaucoma risk among Chinese-Americans.

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Figure 1.
Angle grades according to age

Table 1

Prevalence of Angle Grade by Gender

Shaffer Angle Grade	Prevalence of Grade Among Group		
	Men	Women	Overall
0	17.8%	44.4%	33.3%
Slit	6.7%	4.8%	5.6%
1	13.3%	11.1%	12.0%
2	15.6%	4.8%	9.3%
3-4	46.7%	34.9%	39.8%

Table 2

Comparison of patients with narrow angles versus open angles among glaucoma and at-risk patients

	Eyes with Narrow Angles (Mean $\pm$ SD)	Eyes with Open Angles (Mean $\pm$ SD)	P-value
Age (years)	71 $\pm$ 7	62 $\pm$ 16	0.004
Cup-to-Disk Ratio	0.50 $\pm$ 0.21	0.49 $\pm$ 0.22	0.77
Intraocular Pressure (mmHg)	21.6 $\pm$ 3.8	21.8 $\pm$ 4.2	0.84
Spherical Equivalent (Diopters)	0.50 $\pm$ 1.95	-0.67 $\pm$ 3.45	0.071
Proportion Female	65.1%	34.9%	0.22

P-value represents the significance level of a Mann-Whitney U test comparing the narrow and open angle groups