ASSOCIATION BETWEEN RETINITIS PIGMENTOSA AND PRIMARY ANGLE-CLOSURE GLAUCOMA: A BIOMETRIC ANALYSIS

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Abstract

A type of inherited retinal disease, retinitis pigmentosa (RP), causes patients to lose night vision as they reach adolescence, lose peripheral vision in young adulthood, and finally lose central vision as they age. To determine whether a relationship exists between primary angle-closure glaucoma (PACG) and RP, a retrospective case-control study was conducted in PACG patients with and without concomitant RP. The anterior chamber depth (ACD) was measured using ultrasound biomicroscopy (UBM). The axial length (AL) and lens thickness (LT) of the lenses were measured with A-scan biometry. Analyses were conducted using propensity score matching and mixed linear regression models. During this study, 540 patients with CPACG and 268 patients with APACG were recruited. Twenty-four patients had chronic primary angle-closure glaucoma (CPACG) associated with RP, and twenty-two had acute primary angle-closure glaucoma (APACG) associated with RP. The ACDs, ALs, and relative lens positions (RLP) of patients with PACG associated with RP did not differ significantly from those of patients with PACG alone ($P > 0.05$); however, the LT of patients with APACG associated with RP was significantly higher than that of patients with APACG alone ($P < 0.05$). RP patients with PACG and CPACG had the same biometric parameter characteristics as RP patients without PACG. It is possible that RP and angle-closure glaucoma are related by coincidence.

Keywords: Glaucoma, Retinitis Pigmentosa, Ocular, Biometrics

INTRODUCTION

The retinal pigmentosa (RP) group of disorders occurs when patients lose their night vision in adolescence, then their peripheral vision in young adulthood, then their central vision in later life, due to the progressive loss of rod and cone photoreceptor cells [1-3]. It is also possible for the disease to progress slowly and never result in blindness or rapidly deteriorate, resulting in blindness within less than two decades [4, 5]. A RP prevalence of 1 in 3500 to 1 in 4000 has been reported in the US and Europe, but the prevalence in China is unknown. No data have been reported regarding the prevalence of RP in other populations. The disorder is not particular to a particular ethnic group and occurs at similar frequencies in numerous populations. As a result of RP's severely constricting visual field, most patients become legally blind by the age of 40. There is a faster decline in rod function in typical RP cases than in cone function.

The decline in rod function is more common in RP types that include cone dysfunction [6]. Visual acuity loss and color vision dysfunction are sometimes the most obvious early signs of RP since patients who lose cone sensitivity experience faster loss of rod function than patients who lose cone sensitivity. Cone-rod dystrophy results from these changes. Studies conducted on RP patients with slit-lamp biomicroscopy and ophthalmoscopy have also identified a prevalence of posterior subcapsular cataracts

of approximately 50%. Despite its rarity, many ophthalmologists have observed that glaucoma and RP occur together. It has been reported that the majority of cases have been reported in patient with open-angle glaucoma, particularly in Caucasian populations [7-9]. As part of our studies, which were based on Chinese populations, we observed more patients with RP and angle-closure glaucoma than others. One percent of patients over 40 were affected by primary angle-closure glaucoma (PACG) and RP.
It was believed that angle-closure glaucoma was strongly associated with RP. As compared with the Japanese population, the prevalence of PACG with RP is higher in the Chinese population [10, 11]. There is, however, some controversy about the relationship between glaucoma and RP. Anatomical characteristics of angle-closure glaucoma and RP and their biometric parameters were examined in this study. patients with RP and angle-closure glaucoma than others. One percent of patients over 40 were affected by primary angle-closure glaucoma (PACG) and RP. It was believed that angle-closure glaucoma was strongly associated with RP. As compared with the Japanese population, the prevalence of PACG with RP is higher in the Chinese population [10, 11]. There is, however, some controversy about the relationship between glaucoma and RP. Anatomical characteristics of angle-closure glaucoma and RP and their biometric parameters were examined in this study.

METHODS

Patients with PACG and RP

In this study, a retrospective, clinic-based analysis was conducted. As part of an attempt to help improve patient care, 44 patients with PACG associated with RP were evaluated at the Ophthalmic Center between August and May. The remaining 270 patients were enrolled in a chronic primary angle-closure glaucoma study (CPACG) and 268 patients in an acute primary angle-closure glaucoma study (APACG). In order to diagnose CPACG, the following characteristics were present [12-14]. The synechiae angle is narrow, an IOP $\geq$ 22 mmHg, Glaucomatous optic disc damage resulting in visual field loss, with two or more quarters of the circumference of the angle being lost as a consequence of synechial angle closure, as well as Anterior segment of the eye did not suffer acute ischemic damage as a result of ocular hypertension. The following characteristics were used to diagnose APACG [15]: An acute increase in intraocular pressure and angle closure; It can also involve nausea and vomiting, acute ophthalmalgia, and blurred vision; As well as ciliary or mixed injections, corneal edema, and glaucomatous flecks, ischemic damage can be caused by acute ocular hypertension. The following characteristics were used to diagnose RP.

A description of nyctalopia's symptoms

An enlarged optic disc, epithelial atrophy, and attenuation of the retinal vessels, which are evident on funduscopy, as well as various degrees of pigmentary deposits resembling bone spicules.
According to electroretinography, scotopic system amplitudes were reduced more than photopic system amplitudes, manifested by reduced a-waves and b-waves. A combination of PACG and RP was diagnosed in patients who presented with both characteristics. Both eyes were visible in all patients with CPACG. In the study, the worst eye was chosen based on the results of the visual field test. The study used acute-stage eyes from patients with APACG. Apart from those associated with RP and previous ophthalmological operations, no other abnormalities were observed in patients' funduses [16].

Assessment of ocular biometrics

Each patient underwent a full ocular examination that included visual acuity assessments, IOP measurements with a Goldmann applanation toneometer, slit-lamp biomicroscopy, gonioscopy, and fundoscopy, Humphrey visual field tests, and ultrasound biomicroscopy (UBM). During the examination, the patients remained supine, and fixation and accommodation were maintained at all times. The anterior chamber depth (ACD) of each eye was measured using radial scans in the inferior,

temporal, superior, and nasal quadrants. As part of the biometric evaluation, the axial length (AL) and lens thickness (LT) were measured using a scanner, and the relative lens position (RLP) was determined using the following formula:

$$RLP = [ACD + (1/2)\ LT] / AL$$

Statistical Analyses

Statistical analysis was performed using SPSS 18.0 software (IBM SPSS, Armonk, NY, USA). In both groups (CPACG associated with RP versus CPACG and APACG associated with RP versus APACG), R software and SPSS software with appropriate plug-ins were used for propensity score matching. A 1:4 ratio was used to match the cases. A statistical analysis has shown that the statistical efficiency is greatest when the data ratio between the experimental group and the control group is 1 to 4. Control groups were selected using propensity score matching. According to the nearest neighbor matching principle and the substitution principle, the propensity score logic standard deviation tolerance (caliper) was set to 0.02, preventing multiple selections for an individual case.

A combination of age- and gender-matched patients with CPACG and RP was used to compare patients with CPACG associated with RP. Similar to those with APACG associated with RP, patients with APACG and RP were matched based on age and gender.

We used Fisher's exact testing to compare qualitative variables between groups (constituent ratios). Quantitative variables were expressed as the mean ± standard deviation. t-tests were used to compare normal distributions, and Wilcoxon tests were used to compare abnormal distributions. Each individual enrolled in the study was modeled using mixed linear regression. By assigning random effects to variables with effects that differ between individuals, a mixed-effects model can explicitly specify heterogeneity. The difference between the two groups was analyzed using a linear mixed-effects model and control was made for matching associations within each pair. The limit of statistical significance was set at $P < 0.05$ [17].

RESULTS

This study recruited 24 patients with APACG associated with RP and 24 patients with CPACG associated with RP. As a control group, 270 patients with CPACG and 268 patients with APACG were recruited. APACG associated with RP versus APACG were compared based on propensity score matching (1:4) to account for the differences in gender and age between the two groups. Only 92 patients with CPACG and 84 patients with APACG were selected for the corresponding control groups. No significant differences were observed between the two groups with regard to ACD, AL, or RLP (all $P > 0.05$) (Table 1). The mean ACD, LT, AL, and RLP values in the CPACG associated with RP group were 2.005 ± 0.257 mm, 4.905 ± 0.692 mm, 22.583 ± 0.949 mm, and 0.198 ± 0.021, respectively, and the mean ACD, LT, AL, and RLP values in the CPACG group were 2.044 ± 0.241 mm, 4.894 ± 0.413 mm, 22.353 ± 0.85 mm, and 0.201 ± 0.012, respectively. All ocular biometric parameters measured between the two groups were not significantly different ($P > 0.05$) (Table 1). With respect to AL, ACD, and RLP, we found no significant differences between the two groups when matching associations within each pair were controlled ($P > 0.05$).

The mean ACD, LT, AL, and RLP values in the APACG associated with RP group were 1.673 ± 0.224 mm, 5.395 ± 0.39 mm, 22.112 ± 0.837 mm, and 0.198 ± 0.011, respectively, and the mean ACD, LT, AL, and RLP values in the APACG group were 1.729 ± 0.282 mm, 5.06 ± 0.385 mm, 21.983 ± 0.731 mm, and 0.194 ± 0.014, respectively. With the exception of LT, none of the indicated ocular biometric parameters differed significantly between the two groups ($P > 0.05$). Based on the results of the mixed linear regression model, where we controlled for the matching associations within each pair, there were no significant differences between the two groups regarding AL, ACD, and RLP ($P > 0.05$). A significant difference was found in LT between patients with APACG associated with RP and those with APACG

alone.

Table 1: After matching on propensity scores, eye biometrics in the PACG and RP groups

	CPACG+RP	CPACG	P value	APACG+RP
				APACG
				P value
Number of eyes	24	92		24
				84
Male	10 (43.48%)	44 (47.83%)	0.821	10 (42.86%)
				30 (35.71%)
				0.616
Female	14 (56.52%)	48 (52.17%)		14 (57.14%)
				54 (64.29%)
Age	43.217±15.107	48.204±10.29	0.074	54.952±11.509
				54.638±9.878
				0.824
ACD	2.004±0.254	2.044±0.241	0.497	1.571±0.321
				1.829±0.382
				0.432
LT	4.897±0.701	4.896±0.413	0.944	5.495±0.291
				5.06±0.485
				0.001
AL	22.794±0.951	22.354±0.85	0.259	22.012±0.737
				21.883±0.831
				0.482
RLP	0.199±0.024	0.202±0.012	0.449	0.201±0.013
				0.184±0.024
				0.221

Table 2: RP and CPACG group ocular biometry models is modeled using a mixed linear regression approach

	Regression coefficient	Standard error	t value
			P value
ACD	−0.037	0.037	−1.027
			0.468
LT	0.01	0.074	0.141
			0.93
AL	0.229	0.139	1.665
			0.244
RLP	−0.003	0.003	−1.610
			0.259

Table 3: Mixed linear regression model of ocular biometry in the APACG associated with RP and APACG groups

	Regression coefficient	Standard error	t value
			P value
ACD	−0.057	0.045	−1.198
			0.397
LT	0.334	0.060	5.631
			0.000
AL	0.128	0.129	0.996
			0.482
RLP	0.005	0.003	1.733
			0.224

DISCUSSION

Molecular biometric parameters were examined in PACG associated with RP and PACG patients in a population for the first time. Over the years, there has been considerable controversy surrounding the association between PACG and RP. PACG is more commonly observed in patients with RP than in patients without RP, so clinicians believe the cooccurrence is no coincidence. The anterior chamber of patients with PACG associated with RP also exhibits a shallower shape than the anterior chamber of patients with PACG after trabecular filtration surgery, suggesting other biometric differences between the two groups.

Glaucoma prevalence has been documented to increase in patients with RP in previous reports. We minimized the statistical bias resulting from age and gender mismatches by using a more rigorous statistical method. Compared to patients with CPACG and APACG, patients with PACG associated with RP had almost identical biometric parameters. In patients with APACG associated with RP, LT was significantly greater than in those with APACG alone ($P < 0.05$), which was attributed to ultrasound measurement errors. There was no significant difference between groups after RLP was applied ($P > 0.05$). It is possible that PACG and RP are associated by chance. We noted that patients did not differ significantly in most ocular biometry parameters between the two groups, despite not seeing any significant differences in most parameters.

According to our study, the LT measured by A-scan was inaccurate, so anterior segment optical coherence tomography (OCT) may be a better method. There are still a number of studies that need to be conducted regarding PACG and RP, including iris morphology and anterior chamber volume changes.

CONCLUSION

It should be noted that patients with PACG associated with RP had the same biometric parameter characteristics as those with CPACG and APACG. Perhaps RP and angle-closure glaucoma have a coincidental relationship. The differences in the anterior chamber structures of patients with these diseases require further research.

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