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Original Article

Risk factors for predicting visual field progression in Chinese patients with primary open-angle glaucoma: A retrospective study

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Abstract

Background: Glaucoma is a leading cause of irreversible blindness worldwide. It is characterized by progressive deterioration of the visual field (VF) that results in a complete loss of vision. This study aimed to determine the risk factors associated with VF progression in Chinese patients with primary open-angle glaucoma (POAG).

Methods: We reviewed the charts of POAG patients who visited our clinic between July 2009 and June 2010. We included patients with five or more reliable VF tests using the Humphrey Field Analyzer (Humphrey Instruments, San Leandro, CA, USA) during a period of at least 2 years. The scoring system of the Collaborative Initial Glaucoma Treatment Study (CIGTS) was used to code the VF. Progression was defined as an increasing score ≥ 3, compared to the averaged baseline data. Univariate and multivariate logistic regression analyses were performed to identify the risk factors of VF progression.

Results: There were 92 patients (representing 92 eyes) with an average of 8.9 reliable VFs over a mean follow up of 5.4 years. Multivariate logistic regression showed that eyes with more VF tests [odds ratio (OR) = 1.500, $p < 0.010$] and either increased peak intraocular pressure (IOP) (OR = 1.235, $p = 0.044$) or a wide IOP range (OR = 1.165, $p = 0.041$) favored VF progression. High myopia (less than −6.0 D) was not a risk factor (OR = 1.289, $p = 0.698$) for VF progression in this study.

Conclusion: In addition to a greater number of VF tests, Chinese patients with treated POAG who experienced a high peak IOP or a wide range of IOP during follow up were more likely to have VF deterioration.

Keywords: Chinese; intraocular pressure; myopia; primary open-angle glaucoma; visual field progression

1. Introduction

Primary open-angle glaucoma (POAG) is a leading cause of blindness worldwide.[1] Despite the growing understanding of its pathophysiology and advances in the management armamentarium against glaucoma, the challenges of predicting and halting disease progression remain. The percentage of visual field (VF) progression in open-angle glaucoma have ranged from 12% to 76% in investigations with different study

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designs, populations, treatments, and follow-up periods.[2–9] Candidate factors associated with glaucoma progression include old age,[2–4,6,8] worse baseline mean deviation (MD),[4,6] increased baseline intraocular pressure (IOP), increased mean IOP, increased peak IOP, greater IOP fluctuation during the follow-up period,[2,3,6–10] the presence of disc hemorrhage,[2,6,9] increased number of VF tests,[8] and myopia.[11,12] However, results regarding the role of myopia—a common refractive error and ocular disease in Chinese people—are inconsistent across studies. Debate exists over which IOP-related variable is more closely related to disease progression in treated patients with POAG.

Some studies such as the Advanced Glaucoma Intervention Study (AGIS) show a positive correlation between visit-to-visit IOP fluctuation and VF progression.[3,8,13–15] However, De Moraes et al[9] suggest that the peak IOP rather than IOP fluctuation is a predictor of progression. The latter study is supported by one glaucoma animal study that demonstrated a more predictive role of maximum IOP in structural change, compared to the mean IOP and IOP variability.[16] The role that myopia has in the disease course of POAG similarly remains to be clarified because of its clinical significance and high prevalence in Taiwan. Some studies report that high myopia has an impact on VF exacerbation,[11,12] whereas other studies have found no such correlation.[3,17,18]

Patients with different ethnic backgrounds show variations in the rate of VF deterioration[4]; therefore, they may also differ in the risk factors associated with VF progression. In light of limited data on risk factors for glaucomatous VF progression in Chinese people, we conducted this retrospective study to evaluate the rate of VF progression and determine the associated risk factors in a cohort of Chinese patients with POAG.

2. Methods

We reviewed the medical records of all POAG patients who had regular follow up at our glaucoma service for at least 2 years and maintained their follow-up schedules during the study period between July 2009 and June 2010. The study protocol was approved by the Institutional Review Board of the Taipei Veterans General Hospital (Taipei, Taiwan). The requirement for informed consent was waived (2013-08-010AC).

The diagnosis of POAG was based on normal open angles, glaucomatous optic nerve head changes, and reproducible VF defects of the retinal nerve fiber bundle pattern in at least two consecutive reliable field tests. The Glaucoma Hemifield Test and the pattern standard deviation of VF reports should correspond to outside normal limits and correspond to <5% of the age-matched normal patients, respectively. Patients with a pretreatment IOP ≥22 mmHg were classified as having high-tension POAG (HTG), and patients with a pretreatment IOP <22 mmHg at three or more visits were regarded as having normal-tension glaucoma (NTG). Patients with secondary glaucoma associated with corticosteroid use, trauma, ocular inflammation, or pigment dispersion were excluded. Also excluded were eyes with a patent iridotomy, with a best corrected visual acuity (BCVA) worse than 6/20, or with concomitant ocular disease such as diabetic retinopathy, age-related maculopathy, or neurological diseases that influence VF presentation. Eyes that received cataract extraction or glaucoma surgical intervention during the follow-up period were documented for surgical type and date of intervention.

2.1. VF tests

We retrieved VF tests that were performed using program 24-2 of a Humphrey Field Analyzer 750 (Humphrey Instruments, San Leandro, CA, USA) with the Swedish Interactive Thresholding Algorithm standard. The VF results included in the analysis had to fulfill the reliability criteria that the fixation loss, false-positive results, and false-negative results were all <33%. After excluding the VF tests with inconsistent patterns that reflected a learning effect, the first two reliable consecutive field tests were treated as the baseline fields.

Each VF was then scored, based on the Collaborative Initial Glaucoma Treatment Study (CIGTS) scoring system.[19] In brief, each point with a total deviation probability plot value of ≤5% was considered a depressed location. A weight was administered to each depressed location, depending on the minimum depth of defects among a given point and the neighboring two most defective points. Minimum defects of 0.05, 0.02, 0.01, and 0.005 were administered weights of 1, 2, 3, and 4, respectively. Locations without a probability plot value <0.05 in the two most depressed neighboring locations were given a score of zero. The weight of all 52 points were summed (ranging from 0 to 208), then the sum was scaled (divided by 10.4) to range from 0 (no defect) to 20 (all points show a defect at the $p < 0.005$ level). Eyes with a baseline CIGTS score of ≥18 were excluded from the study. Only eyes that had at least five qualified VF tests over a minimum span of 2 years were included in the analysis. If both eyes of one patient fulfilled the inclusion criteria, the eye with a lower CIGTS score was selected for the final analysis.

2.2. Definition of VF progression

Progression was defined as an increasing CIGTS score of ≥3, compared to the average score of the two baseline fields, and confirmed by two additional tests.[20]

2.3. Statistical analysis

Statistical analyses were performed using statistical software (SPSS, version 17.0; SPSS, Inc., Chicago, IL). A p value < 0.05 was considered statistically significant. Because of the inclusion of 92 patients (13 progressors and 79 non-progressors), the study had 80% of power to detect an OR of 0.4 or 2.5 for progression per one standard deviation change in the covariate ($\alpha = 0.05$).

Age, sex, and variables with $p < 0.2$ in univariate logistic regression analysis were entered stepwise into the multivariate logistic regression analysis. The mean IOP was also