Optic disc morphology in “age-related atrophic glaucoma”

Abstract • Background: This study was performed in order to evaluate whether, in primary open-angle glaucoma (POAG), patients with a different degree of fundus tessellation vary in optic disc morphology and level of intraocular pressure. • Methods: Color stereo optic disc photographs of 562 patients with POAG and a myopic refractive error of less than −8 diopters were morphometrically examined. According to the degree of fundus tessellation, the total group was divided into a tessellated subgroup (n = 256) and a nontessellated subgroup (n = 306), both matched for neuroretinal rim area and refractive error. • Results: In the tessellated subgroup, as compared to the nontessellated subgroup, the mean maximal intraocular pressure values were significantly lower, the parapapillary atrophy was significantly larger, the optic cup was significantly more shallow, frequency of disc hemorrhages was lower, the mean visual field defect was significantly more marked, and patient age was significantly higher. Within the whole study group, the degree of fundus tessellation increased significantly (P<0.005) with decreasing mean maximal intraocular pressure, decreasing optic cup depth, and increasing degree of parapapillary atrophy. In the subgroups with the highest degree of fundus tessellation, parapapillary atrophy was the greatest and the mean maximal intraocular pressure was the lowest compared to other subgroups. • Conclusion: At the low-pressure end of POAG, marked fundus tessellation is associated with large parapapillary atrophy, shallow disc cupping, mostly concentric emaciation of the neuroretinal rim, and high patient age. The results suggest a distinct subtype of POAG in older patients with relatively low intraocular pressure leading to a mainly diffuse atrophy of the optic nerve.

Introduction

Independent of the level of intraocular pressure, primary open-angle glaucoma can be defined by an open anterior chamber angle, typical morphologic or psychophysical evidence of glaucomatous optic nerve damage, and no obvious reason for an elevation of intraocular pressure [14]. In this characterization, differences in the level of intraocular pressure, area of parapapillary atrophy and degree of fundus tessellation [11] are not primarily taken into account. These parameters, however, vary considerably in patients with primary open-angle glaucoma [14, 21]. We conducted the present study to evaluate whether, in patients with primary open-angle glaucoma, subgroups can be formed according to the degree of fundus tessellation and the level of intraocular pressure.
Patients and methods

The study group consisted of 562 Caucasian patients with primary open-angle glaucoma who were participating in an investigation on the biomorphometry of the optic nerve. This investigation involves all patients coming to the eye hospital with any anomaly or disease of the optic nerve.

Selection criteria for the present study were: intraocular pressure readings of more than 21 mmHg or history of it; no obvious reason for an elevation of intraocular pressure; an open anterior chamber angle; glaucomatous changes of the optic disc such as an unusually small neuroretinal rim area in relation to the optic disc size, and an abnormal shape of the neuroretinal rim; localized or diffuse retinal nerve fiber layer defects; and glaucomatous visual field defects. The latter included a mean visual field defect of more than 2 dB or a loss variance of more than 6 dB. Highly myopic eyes with a myopic refractive error of more than -8 diopters were excluded.

For all eyes, 15-deg color stereo optic disc photographs were taken using a telecentric fundus camera. Mixed with photographs of more than 500 patients suffering from other types of glaucomas or other optic nerve diseases, the disc transparencies were projected in a scale of 1 to 15. The outlines of the optic disc, optic cup, zones alpha and beta of the parapapillary chorioretinal atrophy, and the retinal vessels at the temporal inferior, temporal superior, nasal superior, and nasal inferior disc border were plotted on paper and morphometrically analyzed. The parapapillary atrophy was differentiated into a peripheral zone alpha with irregular pigmentation (Fig. 1-4), and a central zone beta with visible sclera and visible large choroidal vessels [21]. The shape of the disc was evaluated as the ratio of the minimal to maximal disc diameter and as the ratio of the horizontal to vertical disc diameter. To obtain the measurements in millimeters or square millimeters, the ocular and photographic magnification was corrected according to Littmann's method using the anterior corneal curvature and the refractive error [27]. The depth of the optic cup was estimated in a scale ranging from 0 for no cupping to 5 for very deep cupping. Tessellated fundus was defined as visibility of the large choroidal vessels at the posterior part of the fundus [11, 21]. It was graded from 0 for "no tessellated fundus" to 3 for "very marked tessellated fundus" (Figs. 1-4).

To determine the reproducibility of the assessment of the optic cup depth, photographs of 20 eyes were re-evaluated five times by the two examiners. The coefficient of reproducibility was calculated as the mean of the standard deviations divided by the mean of the means.

According to the degree of fundus tessellation [11, 21], two subgroups were formed. A nontessellated subgroup included 306 patients without tessellation of the fundus (grade 0), and a tessellated subgroup consisted of 256 patients with a moderate to marked degree of fundus tessellation (grade 1–3) (Table 1). The