RELATIONSHIP BETWEEN CENTRAL CORNEAL THICKNESS, INTRAOCULAR PRESSURE AND SEVERITY OF GLAUCOMATOUS VISUAL FIELD LOSS

CORRELACIÓN ENTRE GROSOR CORNEAL CENTRAL, PRESIÓN INTRAOCULAR Y AFECTACIÓN GLAUCOMATOSA DEL CAMPO VISUAL

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ABSTRACT

Objective: to determine central corneal thickness in normal subjects, glaucomatous patients and ocular hypertension patients, to evaluate if the central corneal thickness is related to the presence of glaucoma or ocular hypertension. Furthermore, we aim to verify the relationship between central corneal thickness and severity of glaucomatous visual field loss.

Methods: comparative study including 150 eyes of 150 subjects, separated into three groups: normal (47 eyes), ocular hypertension (35) and glaucomatous (68). This last group was subdivided in three subgroups depending on the Hodapp-Parrish-Anderson criteria for scoring Humphrey visual field defects (initial, moderate and advanced). We evaluated the visual field, the central corneal thickness measured by pachymetry and the intraocular pressure measured by Goldmann tonometry. Results were analysed using the Student’s t-test for normally distributed independent samples.

Results: the central corneal thickness was 526±25 microns (mean ±standard deviation (SD)) in glaucomatous patients, 560±27 microns in ocular hypertension patients and 580±20 microns in normal subjects. The central corneal thickness was significantly different among the three groups (p<0.001). There was a correlation between central corneal thickness and glaucomatous visual field loss (p<0.001).

RESUMEN

Objetivo: Determinar el grosor corneal central (GCC) en sujetos normales, pacientes glaucomatosos e hipertensos oculares, valorando si el GCC está asociado con la presencia de glaucoma o de hipertensión ocular. Por otra parte, comprobar la correlación entre el GCC y el estadio de afectación del campo visual (CV).

Método: Se realizó un estudio de casos y controles, con 150 ojos de 150 pacientes, divididos en tres grupos: normales (47 ojos), hipertensos oculares (35) y glaucomatosos (68). A su vez, se establecieron tres subgrupos dentro de los sujetos glaucomatosos, dependiendo de la afectación del CV según la clasificación de Hodapp de defectos del campo visual (inicial, moderada y avanzada). Se valoró la campimetría, la medida del GCC mediante pachimetría ultrasónica y de la PIO con tonómetro de aplanación de Goldmann (TAG). Se aplicó el test de hipótesis t-Student para muestras independientes que siguen una distribución normal.

Resultados: La media del GCC en los pacientes glaucomatosos era 526 micras Desviación Estándar...
INTRODUCTION

Intraocular pressure (IOP) is one of the most significant parameters in the diagnosis and treatment of glaucoma. Goldman’s applanation tonometer (GAT) is still the «gold standard» method used to measure intraocular pressure (1,2). Several studies have demonstrated a positive linear correlation between IOP and CCT determined by means of pachymetry, suggesting an underestimation of IOP in thin corneas and an overestimation in thick corneas (1,3). The OHTS (Ocular Hypertension Treatment Study) defined thin corneas as a risk factor in ocular hypertensive individuals to develop manifest glaucoma (4). Herdon et al described CCT as a significant clinical factor to be taken into account when determining the severity of glaucoma upon initial examination by the specialist doctor (5).

On the other hand, the study of visual field (VF) is to date the main test used to diagnose glaucomatous disease, and even before introducing new diagnostic methods for this pathology it is necessary to take it into account VF in order to validate diagnosis (2).

The present study seeks to determine mean CCT in normal subjects within our population and compare it to that of glaucoma and ocular hypertensive patients. Furthermore, it seeks to study the correlation existing between pachymetric measurements and the stage of visual field involvement in subjects diagnosed with glaucoma, and thus consider pachymetry as a potential risk factor independent from the progression of glaucomatous disease.

SUBJECTS, MATERIAL AND METHODOLOGY

The case-control study included 150 eyes of 150 patients aged 25 to 78 attending the Ophthalmology Unit at our center.

Patients suffering from corneal edema, keratoplasty, previous cataract surgery, phthisis bulbi or optic disc morphological abnormalities (large and oblique papillae) were excluded from the study.

The results obtained for each patient in the last automated perimetry performed during the past six months by means of a Humphrey Field Analyzer perimeter, model 745 (standard 24-2 SITA strategy) were assessed. As a preliminary requirement, the perimetry had to fulfill the reliability criteria (6) and should not be the patient’s first VF; CCT was expressed in microns and measured using the ultrasonic Pacline pachymeter (Optikon 2000, Rome, Italy) (considering the mean of the five measure-
ments taken by the same examiner as the real value); IOP was measured with GAT; and papillary excavation was assessed under pharmacological midriasis with a 90D non-contact lens. The study included three different groups:

1. Group of control subjects (47 eyes): with no evident ophthalmic pathology, IOP ≤ 21 mmHg and no lesions in the perimetry or examination of the optic nerve head.

2. Group of ocular hypertensive patients (35 eyes): IOP > 21 mmHg, no visual field or optic disc alterations.

3. Group of glaucomatous patients (68 eyes): IOP and visual field lesions and/or morphological changes in the papilla suggesting the presence of glaucoma under pharmacological and/or surgical control. Patients in this group were again divided into three subgroups depending on the degree of VF involvement according to Hodapp classification (7):
   a) Initial (18 eyes).
   b) Moderate (22 eyes).
   c) Advanced (28 eyes).

R and SPSS (SPSS Inc, Illinois, USA) software was used to perform the statistical analysis. The t-Student hypothesis test was applied to the independent samples following a normal distribution. Results were considered statistically significant when p< 0.05.

CCT was assumed to present a normal distribution, since this is a continuous variable sampled from a natural population. The validity of the normalcy hypothesis was verified comparing the measured CCT values against the values randomly generated and following a normal distribution using «q-q plot» graphs.

The t-Student statistical analysis verified the presence of statistically significant differences in CCT for all groups under consideration: control subjects, glaucomatous patients and ocular hypertensive individuals. Additionally, the t-Student analysis was used to determine whether statistically significant differences existed in terms of CCT for each subgroup present within the glaucomatous patients group.

RESULTS

150 eyes of 150 patients were included in the analysis, of which 47 (31.33%) eyes belonged to the control group; 35 (23.33%) to the group of ocular hypertensive subjects; and finally 68 (45.33%) to that of glaucomatous patients, of which 18 (26.47%) showed initial VF involvement, 22 (32.35%) moderate involvement and 28 (41.17%) advanced involvement.

Mean central corneal thickness was 556 microns SD 27 in the group of normal subjects; 560 SD 27 in the hypertensive group; and 526 SD 25 in the glaucomatous group (table I). Mean differences among the three groups were significant between the glaucomatous and ocular hypertensive groups (34; p< 0.01), as well as between the glaucomatous and normal subjects (30; p< 0.01), not so among the hypertensive group and case controls (–4.5; p= 0.45) (fig. 1).

As for the glaucomatous subgroups based on VF involvement, mean CCT for eyes presenting initial VF involvement was 532 microns SD 28; 534 SD 22 for eyes with moderate VF involvement; and 517 SD 22 for advanced VF involvement (Table II). Mean differences among patients suffering from initial and moderate visual field involvement was not significant (-2 microns; p= 0.7), while the opposite was true for patients suffering from initial and advanced visual field damage (17 microns; p< 0.05) and those with moderate and advanced VF involvement (13 microns; p< 0.01) (fig. 2).

DISCUSSION

The results obtained suggest that CCT is significantly thicker in the control and ocular hypertensive groups than among glaucomatous patients. These findings are in agreement with those published in the references reviewed (1-5,8-10). On the other hand, according to the present study, CCT could also be related to the stage of VF involvement, a statistically significant association existing between both variables; no unanimous agreement was found with respect to this issue in the studies published to

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<th>Table I. Mean CCT, typical deviation and mean typical error in the control subjects, OHT and glaucomatous group</th>
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date. Jonas et al (11), Sullivan-Mee et al (12) and trials such as the «Early Manifest Glaucoma Trial (EMGT)» (13) agree on the fact that CCT should not be considered as a significant risk factor in the progression of glaucoma. However, Herndon et al (5), Medeiros et al (9), «The Ocular Hypertension Treatment Study (OHTS)» (4) and even Sullivan-Mee et al support the present results in subsequent publications (14), finding thin CCTs as risk factors predictive of VF loss.

The reason behind such conflicting results is not quite clear. It may be due to differences in study design (differences in the populations included in every study and the criteria used to define VF loss or involvement, as well as the treatment prescribed in each study).

The fact that CCT in ocular hypertensive subjects and control cases is greater than glaucomatous patients’ suggests that thick corneas may prevent glaucomatous damage and vice versa, thin corneas could pose a greater risk in terms of damage progression (3,15,16).

Finally, the results obtained prove that CCT in glaucomatous patients is significantly lower than among normal subjects and ocular hypertensive patients. Furthermore, a statistically significant relation was found between CCT and VF, i.e. there is a greater visual field loss among patients with lower CCTs. Thus the relevance of quantifying CCT in glaucomatous subjects, since lower CCTs
should entail lower target IOPs than normal CCTs (1,3-5,8,9,11).

REFERENCES


