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CORNEAL BIOMECHANICS INVOLVEMENT IN PRIMARY OPEN ANGLE GLAUCOMA PATIENTS

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The aim of these study was to investigate the role of corneal biomechanical properties in patients with primary open angle glaucoma. Out of 107 eyes examined from 57 patients, 98 met the inclusion criteria and were divided into two groups based on the presence or the absence of primary open angle glaucoma. Every patient underwent a complete ophthalmologic examination and then Ocular Response Analyzer (ORA) was used in order to determine corneal biomechanical properties such as corneal hysteresis (CH) and corneal resistance factor (CRF). For statistical analysis we used descriptive analyses and linear regression. Out of the 98 eyes examined 57 with POAG were included in the first group, while 41 eyes with no ocular disorder were included in the control group, the second group. The mean of corneal hysteresis was lower in the first group (9.48±1.97) than in normal individuals (11.06±1.41). Mean CRF was also lower in POAG patients (10.46±1.82) than in the control group (11.43±1.54). A negative correlation was found between CH and intraocular pressure (IOP) in both glaucoma patients(r=-0,27, p<0.0005) and normal individuals(-0.48, p<0.0005). Our study shows that corneal hysteresis and corneal resistance factor are considerably lower in POAG patients than in normal individuals and also, a low value of CH correlates with a high value of the IOP.
Corneal biomechanical properties represent a group of parameters that are obtained through an easy non-invasiv measurement and can be used in the evaluation of the primary open angle glaucoma patients.

Keywords: corneal biomechanics, hysteresis, glaucoma

INTRODUCTION

The role of corneal biomechanical properties has been studied more and more recently. It has been demonstrated the involvement of corneal hysteresis and corneal resistance factor, along with the central corneal thickness (CCT) and intraocular pressure (IOP) in the management of glaucoma patients[1]. There are studies have shown that corneal hysteresis varies between individuals, influences the measurements of the intraocular pressure and is related to the capacity of the optic nerve to tolerate high levels of the IOP[1-7].

The Ocular Response Analyzer is able to determine both corneal hysteresis and corneal resistance factor along with Goldman intraocular pressure and corneal compensated intraocular pressure using an air pulse that determines the cornea to move inward and then outward. The device measures this way the corneal response to the air pulse deformation[2,5,8,9].

Corneal hysteresis reflects the viscoelastic properties of the cornea revealing its capacity of absorbing and dissipating energy while corneal resistance factor shows the global resistance of the cornea. IOPg represents a measurement of the IOP that corresponds to the Goldmann applanation tonometry, while IOPcc determines another value for the IOP, this time adjusting it for the corneal biomechanichal properties of that eye. There are studies that sustain this statement revealing that the ORA measurements of the IOP are unrelated to the CCT[2, 3-5].

MATERIAL AND METHODS

This was an observational study that involved 107 eyes from 57 patients. Out of the 107 eyes examined, 98 eyes met the inclusion criteria and were divided into two groups: first group consisted of 57 POAG eyes and the second group 41 normal eyes. Inclusion criteria for the first group consisted of primary open angle glaucoma patients with glaucoma optic neuropathy (excavation asymmetry between the two eyes 0,2 or more or cup/disc ratio 0,6 or more and retinal nerve fiber layer defects) and visual field damage (Glaucoma Hemifield Test: Outside normal Limits or low MD) and/or peripapillary hemorrhages. For the second

group the inclusion criteria represented eyes with no history of ocular disorder, normal IOP measurements, normal retinal nerve fiber layer, symmetric excavations and cup/disc ratio 0,5 or less and normal visual field test.
All the patients underwent a complete ophthalmological examination that included best corrected visual acuity, slit lamp examination of the anterior pole, IOP measurements using Goldmann applanotonometer, ultrasound pachimetry (Alcon® OcuScan® RxP Ophthalmic Ultrasound System), gonioscopic examination using a Goldmann lens with three mirrors, visual field analyses using Humphrey Field Analyzer II (Carl Zeiss Meditec Inc, Dublin, California) strategy 24-4 and fundus examination. The ORA was used in order to determine IOPg, IOPcc, CH and CRF. We determined 4 measurements on each eye with waveform score higher than 7 and we used the best measurement in the study.

RESULTS AND DISCUSSIONS

Out of the 57 patients, 32,65% were men, while 67,35% were women. The mean IOP was 20.19 ± 5.28 in POAG patients group and 16.41 ± 2.82 in the second group. Central corneal thickness had the means of about 544.96 ± 40.63 in the first group and 590.75 ± 35.79 in the control group. The mean of corneal hysteresis 9.48±1.97 was in the first group and 11.06 ± 1.41 in normal individuals. Mean CRF was 10.46 ± 1.82 in POAG patients and 11.43 ± 1.54 in the control group.
Linear regression analyses showed a moderate negative correlation statistically significant between CH and intraocular pressure (IOP) both in primary open angle glaucoma patients(r= -0,27, p<0.0005) (Figure 1) and normal individuals (r= -0.48, p<0.0005). Corneal resistance factor did not correlate with IOP: r= 0.04, p<0.1 for the first group and r= 0.05, p<0.1 for the second group.
A positive correlation was found between CH and CCT in the first group (r=0.41, p<0.0001) (Figure 2) and in the second group(r=0.23, p<0.22). CRF also correlates statistically significant with CCT in both groups: for the POAG group r=0.43,p<0.0001 and for the control group r=0.81, p<0.0001.
Recent studies showed the involvment of corneal hysteresis in the severity of glaucoma and visual field loss[7,6] while others show that CH represents a risk factor independent of the IOP[8].
Our study reveals that in primary open angle glaucoma patients intaocular pressure was higher than in the normal individuals while central corneal thickness, corneal hysteresis and corneal resistance factor were lower.

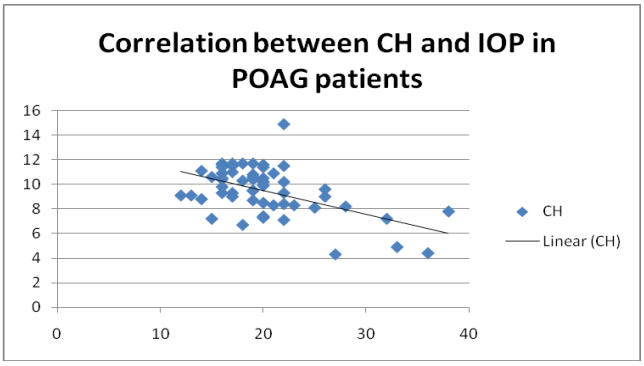

Figure 1. Correlation between corneal hysteresis and intraocular pressure in primary open angle glaucoma patients

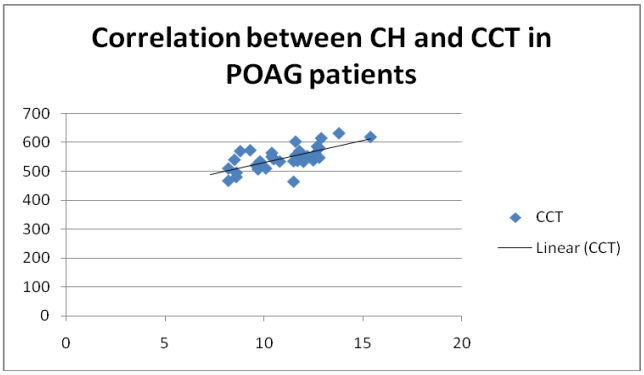

Figure 2 Correlation between corneal hysteresis and central corneal thickness in primary open angle glaucoma patients

This demonstrates that corneal biomechanical properties can be used along with IOP in the evaluation of the glaucoma patients. Also, ORA measurements are easy to take and noninvasive making it an usefull tool in ophthalmology examination.
We determined that low corneal hysteresis is associated with a high intraocular pressure in both glaucoma patients and normal individuals showing once again that a low value of CH represents a risk factor for glaucoma patients. An eye with a low corneal hysteresis has a lower ability to absorb energy and in the presence of a high intraocular pressure, the cornea can not absorb energy and all the pressure presses the optic nerve and peripapillary tissues. This means that an eye that has a high CH has a protective factor for glaucoma becouse the cornea is able to absorb part of the energy in case of an IOP rise.
Corneal resistance factor correlates with central corneal thickness in both groups explaining once again how the CRF is a representation of the global resistance of the cornea and its importance in primary open angle glaucoma eyes.

A low dumping capacity of the cornea in glaucoma patients is also sustained by the correlation between corneal hysteresis and central corneal thickness raising the risk of developing optic nerve neuropathy.
It has been suggested that high levels of the IOP found in glaucoma patients determine a remodelation of the cornea changing its corneal biomechanical properties, especially the hysteresis[2]. Our results reveal a correlation between CH and IOP in glaucoma patients and a lower hysteresis value in glaucoma patients than in normal eyes. This being consistent with previous studies and showing once again that corneal biomechanical properties are modified in glaucomatous eyes.

CONCLUSIONS

In summary, our data suggested that a low corneal hysteresis and corneal resistance factor associated to a high intraocular pressure represent a risk factor for optic nerve damage in glaucomatous eyes. Also, Ocular Response Analyzer can be used as a tool in evaluating POAG patients.

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