Journal of Optometry (2016) 9, 118–125

Journal of Optometry

www.journalofoptometry.org

ORIGINAL ARTICLE

Intraeye retinal nerve fiber layer and macular thickness asymmetry measurements for the discrimination of primary open-angle glaucoma and normal tension glaucoma

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Received 26 July 2015; accepted 27 September 2015
Available online 1 December 2015

KEYWORDS
Retinal nerve fiber layer;
Macular thickness;
Asymmetry;
Glaucoma

Abstract
Purpose: The aim of this study was to evaluate the diagnostic capability of intraeye retinal nerve fiber layer (RNFL) thickness and macular thickness (MT) asymmetry measurements for the discrimination of normal tension glaucoma (NTG) and primary open-angle glaucoma (POAG) using spectral domain optical coherence tomography (SD-OCT).
Methods: A total of 90 subjects were enrolled including 30 consecutive healthy subjects, 30 consecutive subjects with POAG, and 30 consecutive subjects with NTG. RNFL thicknesses around the optic disc as well as MT measurements were taken with circular and radial SD-OCT scans. Intraeye retinal and MT asymmetry were calculated as the absolute difference between superior and inferior hemispheres of the eye using posterior pole asymmetry analysis protocol. Analysis of variance was used for comparison and areas under the receiver operating characteristic (AROC) were obtained for different parameters among the three diagnostic groups.
Results: There was a significant difference in MT asymmetry for all comparison groups (normal-NTG, $p < 0.05$; normal-POAG, $p < 0.001$; and NTG-POAG, $p < 0.001$). Intraeye retinal nerve fiber thickness asymmetry measurements were not different between the groups (normal-NTG, $p < 0.187$; normal-POAG, $p < 0.056$; and NTG-POAG, $p < 0.837$). The area under ROC curves exceeded 0.800 for all the studied parameters, including the MT asymmetry except for intraeye RNFL thickness asymmetry which had the lowest AROC as well as the least sensitivity for

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http://dx.doi.org/10.1016/j.optom.2015.10.002

identifying subjects with NTG from normal (AROC = 0.626, sensitivity = 30%); POAG from normal (AROC = 0.644, sensitivity = 37%) and NTG from POAG (AROC = 0.533, sensitivity = 13%).
Conclusion: The intraeye MT asymmetry holds significant potential as a distinguishing parameter for NTG and POAG.

PALABRAS CLAVE
Capa de fibras nerviosas de la retina;
Grosor macular;
Asimetría;
Glaucoma

Mediciones intraoculares de las capas de fibras nerviosas de la retina y de la asimetría del grosor macular para la discriminación del glaucoma primario de ángulo abierto y el glaucoma normotensional

Resumen
Objetivo: El objetivo de este estudio fue el de evaluar la capacidad diagnóstica de las mediciones intraoculares de la asimetría del grosor de las capas de fibras nerviosas de la retina (RNFL) y del grosor macular (MT) para la discriminación del glaucoma normotensional (NTG) y el glaucoma primario de ángulo abierto (POAG), mediante tomografía de coherencia óptica de dominio espectral (TCO-DE).
Métodos: Se incluyó a un total de 90 sujetos, de los cuales treinta eran sujetos sanos consecutivos, treinta sujetos consecutivos con POAG, y treinta sujetos consecutivos con NTG. Los grosores de RNFL alrededor del disco óptico, así como las mediciones de MT, se obtuvieron mediante TCO-DE circular y radial. La asimetría intraocular retiniana y de MT se calcularon como diferencia absoluta entre los hemisferios oculares superior e inferior, utilizando el protocolo de análisis de asimetrías del polo posterior. Se utilizó para la comparación el análisis de la varianza, obteniéndose las áreas bajo la curva de características operativas del receptor (AUROC) para los diferentes parámetros en los tres grupos diagnósticos.
Resultados: Se produjo una diferencia significativa en relación a la asimetría de MT para todos los grupos comparativos (normal-NTG, $p < 0{,}05$; normal-POAG, $p <$,001y NTG-POAG, $p < 0{,}001$), mientras que las mediciones intraoculares de la asimetría del grosor de las fibras nerviosas de la retina no reflejaron una diferencia entre los distintos grupos (normal-NTG $p < 0{,}187$, normal-POAG, $p < 0{,}056$y NTG-POAG, $p < 0{,}837$). El área bajo la curva superó el valor de 0,800 para todos los parámetros en estudio, incluyendo la asimetría de MT, exceptuando la asimetría intraocular del grosor RNFL, que reflejó el menor valor de AUROC, al igual que una menor sensibilidad para la identificación de los sujetos con NTG respecto a los normales (AUROC = 0,626, sensibilidad = 30%), POAG respecto a los normales (AUROC = 0,644, sensibilidad = 37%) y NTG respecto a POAG (AUROC = 0,662, sensibilidad = 13%).
Conclusión: La asimetría intraocular de MT tiene un potencial significativo como parámetro distintivo de NTG y POAG.

Glaucoma is an optic neuropathy characterized by the progressive degeneration of retinal ganglion cells (RGCs) and their axons leading to a concurrent visual field loss. Intraocular pressure (IOP) has been recognized as the only treatable risk factor for primary open-angle glaucoma (POAG) and is considered a determining feature of POAG. However, an emerging perspective relates IOP in glaucoma description rather than in defining the disease process.[1] The general practice among eye care professionals has been to classify POAG into two distinct entities based on IOP. Glaucomatous optic neuropathy (GON) in the presence of IOP higher than 21 mm Hg being described as high-tension glaucoma and is commonly referred to as POAG[2] and all other cases are referred to as either low-tension glaucoma or normal-tension glaucoma (NTG).[3] Studies have previously established a positive effect of IOP reduction on disease progression in both NTG and POAG.[4–6] Nonetheless, various additional risk factors, such as ocular and systemic circulation abnormalities, have been linked to the cause and progression of both POAG[7–9] and NTG.[10,11] NTG has long been considered a class of POAG on account of a multitude of similar attributes. However, studies have demonstrated thinner neuroretinal rims, deeper and steeper-sided visual field defects, and greater prevalence of disc hemorrhages in NTG patients compared with POAG patients.[12–14]

In both structure and function, asymmetry has been a well known characteristic of POAG. Previous research has demonstrated intraeye asymmetry between superior and inferior measures of visual field sensitivity,[15,16] retinal nerve fiber layer (RNFL) thickness,[17,18] neuroretinal rim width,[19,20]