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Editorial

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Glaucoma Diagnosis: Past, Present and Future

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Glaucoma diagnosis is one of the most challenging situation in ophthalmology. In daily clinical practice, many of glaucoma patients are missed on diagnosis and a lot of those receiving antiglaucoma therapy may not have the disease. This difficulty may be attributed to sensitivity and specificity of the diagnostic tools as well as the nature of disease in its early stages. In the past, subjective clinical evaluation of optic nerve head and Retinal Nerve Fiber Layer (RNFL) photography enabled diagnosis but with wide variability even among expert observers. Visual field analysis is a major subjective beneficial test, but requires patient cooperation, frequently shows fluctuation. Even tests with reliable indices should be repeated several times to ensure a reproducible defect.

At present, diagnosis has been switched to objective computerized analysis techniques including Spectral domain-optical coherence tomography (SD-OCT). Given the fact that, structural changes precedes functional changes, peripapillary NFL thickness measurement is the most sensitive and discriminating parameter for glaucoma diagnosis up to the moment.[1,2] The ability of SD-OCT to differentiate between normal, glaucoma suspect and glaucomatous eyes is better for RNFL thickness than optic nerve head parameters.[3] With a specificity of 95%, Kuang, et al.[4] found that up to 35% of glaucoma suspect eyes had OCT- RNFL defects 4 years prior to perimetric glaucoma, and 19% of eyes had abnormal OCT results 8 years before visual field defects. Furthermore, application of OCT may revolutionize our knowledge about disease mechanisms. Based on OCT findings, Hood, et al.[5] found that the inferior arcuate bundle − though thicker − is narrower than the superior one at comparable locations. They suggested a crowding hypothesis for glaucomatous damage according to these OCT data.

Although, total macular thickness measured with OCT was found to decrease in glaucomatous patients. Its diagnostic power is much less than peripapillary RNFL thickness.[6] Total macular thickness measurement includes outer retinal layers which are spared in glaucomatous damage. So, researches had been focused on inner retinal layers that are specifically affected by glaucoma; namely: nerve fiber layer, ganglion cell layer and inner plexiform layer. These layers were collectively called the Ganglion Cell Complex (GCC) and proved to have high diagnostic power − that is − on par with and complementary to peripapillary RNFL thickness. The ganglion cell layer occupies about one third of the macular region. In this way, another anatomical area; the macular region had contributed to glaucoma diagnosis.[7]

Imaging of optic disc margin was tried and could illustrate border tissue of Elschnig. The latter is fibrous tissue that arises from anterior surface of sclera and fuses with termination of Bruch's membrane to separate axons of ganglion cells from choroidal circulation as they pass through the scleral canal. Its anatomy determines what structure is perceived clinically as the edge of the optic disc. According to their research, Reis, et al.[8] found that the clinically visible disc margin corresponds to border tissue of Elschnig or both Bruch's membrane with underlying border tissue. Less frequently, it corresponds to termination of Bruch's membrane. Therefore, the clinically visible disc margin differs from SD-OCT detected disc margin which is considered the termination of Bruch's membrane. This finding has important implication for the automated detection of the disc margin and estimates of the neuroretinal rim area.

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Still in the region of optic disc where OCT could clearly demonstrate the three dimensional structure of lamina cirbrosa (LC). It appears as highly reflective structure with distinct anterior and posterior boundaries that facilitate measurement of its thickness. The thickness of LC is reduced in glaucomatous patients and was found to correlate with mean deviation in ocular hypertensive, moderate and severe stages of glaucoma.[9] Laminar pores appear on enhanced depth imaging OCT as multiple small full thickness laminar perforations (<100 microns in diameter). In glaucomatous eyes, laminar defects were frequently seen and may be associated with focal retinal nerve fiber layer damage. Laminar defects should be more than 100 μ in diameter and 30 μ in depth.[10]

In the near future, OCT angiography my update our knowledge about pathogenesis, progression and management of glaucoma. Vascular dysfunction is one of the suggested mechanisms for glaucomatous damage. Reduced optic nerve head and peripapillary blood flow dynamics in glaucoma was shown by laser doppler flowmetry. Using the new Splits Spectrum Amplitude-Decorrelation Angiography (SSADA) algorithm on a custom swept-source OCT system, Jia, et al.[11] showed decreased optic disc perfusion in glaucoma. They showed attenuation of the dense peripapillary microvascular network and reduced disc flow index by 25% in glaucomatous eyes. The flow index value was highly correlated with visual field pattern standard deviation. In addition, different vascular beds including retinal, choroidal and sclera/lamina cirbrosa vascular networks were imaged and showed attenuation compared to normal subjects. Using OCT angiography, reduced peripapillary retinal perfusion in glaucomatous eyes could be visualized as focal defects and quantified as peripapillary flow index and peripapillary vessel density, with high repeatability and reproducibility.[12] Future researches will provide a deeper insight about role of disc perfusion in the course of glaucoma and possibly its progression. Lower flow index values may be added to risk factors that determine treatment strategy in preperimetric and perimetric glaucoma.

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