Editorial

OCT in Glaucoma Diagnosis

Nadeem Hafeez Butt

Pak J Ophthalmol 2018, Vol. 34, No. 1

Ocular coherence tomography (OCT) has revolutionized the diagnosis of glaucoma since it was launched as a time domain machine. With advancements in technology fourier domain and swept source machines have been introduced with very high resolution. A higher scan speed of OCT machines (80,000 to 100,000 scan/sec) has made it possible to get a uniform sensitivity over the entire scan window showing both RNFL and lamina cribrosa. World glaucoma association consensus on diagnosis of glaucoma states that clinical diagnosis of glaucoma is predicted on the detection of a thinned retinal nerve fiber layer and narrowed neuroretinal rim which can now be studied in detail with higher resolution machines.

With swept source OCT there is increased penetration to choroid and sclera. There is better visualization even in cataract therefore you can assess glaucoma damage before cataract surgery. Glaucoma has always been diagnosed with visual field changes but with the advent of OCT the term pre-perimetric glaucoma has been established which literally means glaucoma with normal perimetry. OCT has also become a useful tool for high myopes who are at risk for developing glaucoma. There is a risk of false positives in myopic patients due to the presence of peripapillary atrophy. This can be verified by ganglion cell layer analysis which is the earliest form of glaucoma damage which can be picked up by OCT. Optic nerve can also be visualized using enface imaging or angio OCT. Moreover all the OCT machines have the capability to do an OCT analysis of the angle and the corneal thickness. Pachymetry helps to give a corrected reading of intraocular pressure and angle analysis is crucial in patients with narrow angle and plateau iris.

The Hood Glaucoma report[1] has been recently developed and it aids in the understanding of glaucoma better using multiple parameters. This includes OCT B scan of circumpapillary RNFL with reference database, correlation of OCT RNFL data (structure) with visual field test locations (function), wide field OCT enface image, wide field RNFL thickness map, circumpapillary RNFL thickness 4 sector and 12 clock charts with reference database, GCL + IPL thickness map, correlation of OCT GCL + IPL data (structure) with visual field test locations (function). It is generally thought that local defects are most often seen in the superior and inferior quadrants. For example, OCT studies typically find that circumpapillary retinal fiber layer (cpRNFL) thinning of the superior and inferior quadrants is a more sensitive measure of glaucomatous damage than is thinning of the temporal or nasal quadrants.[2] However, according to Hood et al[3], it is the temporal half of the superior and inferior quadrants (i.e., 45° to 90° and −45° to −90° that are particularly vulnerable to early local damage. This is consistent with OCT cpRNFL thickness data suggesting that 6, 7, 11, and 12 are the clock hours of the disc that are most likely to be affected by glaucomatous damage.

Evaluation of deep optic nerve head and parapapillary microvasculature in glaucoma has been made possible with Angio OCT.[4] It helps in diagnosis, predicting glaucoma development in glaucoma suspect and seeking pathogenesis. Deep retinal layer microvasculature dropout has been detected by the OCT-A in glaucoma. This has been verified by a comparative study using OCT-A and ICG angiography.[5] Posterior displacement of the lamina cribrosa happens in glaucoma leading to increased mean lamina cribrosa depth in patients with glaucoma[6]. In patients with glaucoma the central and mid peripheral Lamina Cribrosa is located more posteriorly than in normal eyes. Similar observation is seen in eyes with defects in visual fields (VF) compared to fellow eyes with no VF defects. Lamina cribrosa curvature Index (LCCI) has a better

discriminating capability than Lamina cribrosa (LC) depth in diagnosis of patients with glaucoma[7]. It has been shown that eyes with greater LCCI lose retinal nerve fiber layer (RNFL) more rapidly.

Progressive thinning of macular ganglion cell inner plexiform layer (GCIPL) and thinning of parapapillary RNFL are correlated strongly with each other. Progressive GCIPL and RNFL thinning indicate progression of glaucoma visual fields. Therefore macular GCIP and parapapillary RNFL readings have been incorporated into the guided progression analysis (GPA)[8] for picking up deterioration in patients with glaucoma early.

Thinning of RNFL on OCT occurs more rapidly in patients having localized progressive RNFL defects than patients with RFNL defects which are localized and constant. This has been shown in Trend based progression analysis (TPA).[9] Data suggests that we can get a useful analysis of glaucoma progression if RNFL thickness on OCT is analyzed using a trend-based strategy. Other diagnostic tests may be complemented with it as well. Retinal nerve fiber layer optical texture analysis (ROTA) for detection of glaucoma in color fundus photographs compared with quantitative analysis of OCT RNFL thickness on normal subjects has shown that local mean value, standard deviation, and Shannon entropy extracted from the green and blue channel of fundus images are correlated with corresponding RNFL thickness[10].

In conclusion OCT has made significant changes in our understanding of glaucoma and has nearly replaced the visual field test as an objective test with high reliability.

Author's Affiliation

Prof. Nadeem Hafeez Butt
Department of Ophthalmology
Allama Iqbal Medical College, Lahore

REFERENCES

1. **Hood DC.** Improving our understanding, and detection, of glaucomatous damage: An approach based upon optical coherence tomography (OCT). Prog Retin Eye Res. 2017 Mar; 57: 46-75.
2. **Kanamori A, Nakamura M, Escano MF, Seya R, Maeda H, Negi A.** Evaluation of the glaucomatous damage on retinal nerve fiber layer thickness measured by optical coherence tomography. Am J Ophthalmol. 2003; 135: 513–520.
3. **Hood DC, Wang DL, Raza AS, de Moraes CG, Liebmann JM, Ritch R.** The locations of circum papillary glaucomatous defects seen on frequency-domain OCT scans. Invest Ophthalmol Vis Sci. 2013b; 54: 7338–7343.
4. **Lee EJ, Kim TW, Lee SH, Kim JA.** Underlying Microstructure of Parapapillary Deep-Layer Capillary Dropout Identified by Optical Coherence Tomography Angiography. Invest Ophthalmol Vis Sci. 2017 Mar. 1; 58 (3): 1621-1627.
5. **Lee EJ, Lee KM, Lee SH, Kim TW.** Parapillary choroidal microvasculature drop out in glaucoma; a comparison between Optical coherence tomography angiography and indocyanine green angiography. Ophthalmology, 2017 Aug; 124 (8): 1209-1217.
6. **Furlanetto RL, Park SC, Damle UJ, Sieminski SF, Kung Y, Siegal N, Liebmann JM, Ritch R.** Posterior displacement of the lamina cribrosa in glaucoma: in vivo inter individual and inter eye comparisons. Invest Ophthalmol Vis Sci. 2013 Jul. 18; 54 (7): 4836-42.
7. **Lee SH, Kim TW, Lee EJ, Girard MJ, Mari JM.** Diagnostic Power of Lamina Cribrosa Depth and Curvature in Glaucoma. Invest Ophthalmol Vis Sci. 2017 Feb. 1; 58 (2): 755-762.
8. **Hou HW, Lin C, Leung CK.** Integrating Macular Ganglion Cell Inner Plexiform Layer and Parapapillary Retinal Nerve Fiber Layer Measurements to Detect Glaucoma Progression. Ophthalmology, 2018 Feb. 9. pii: S0161-6420(17)32732-X. doi:10.1016/j.ophtha.2017.12.027.
9. **Lin C, Mak H, Yu M, Leung CK**. Trend-Based Progression Analysis for Examination of the Topography of Rates of Retinal Nerve Fiber Layer Thinning in Glaucoma. JAMA Ophthalmol. 2017 Mar. 1; 135 (3): 189-195.
10. **Odstrcilik J, Kolar R, Tornow RP, Jan J, Budai A, Mayer M, Vodakova M, LaemmerR, Lamos M, Kuna Z, Gazarek J, Kubena T, Cernosek P, Ronzhina M.** Thickness related textural properties of retinal nerve fiber layer in color fundus images. Comput Med Imaging Graph, 2014 Sep; 38 (6): 508-16.