Print ISSN: 2321-6379
Online ISSN: 2321-595X
DOI: 10.17354/ijss/2017/52

Original Article

Role of Optical Coherence Tomography and Scanning Laser Polarimetry (GDx Variable Corneal Compensation) in the Assessment of Retinal Nerve Fiber Layer in Primary Acute Angle Closure Glaucoma

Md Nazarul Islam[1], Mita Saha (Dutta Chowdhury)[2], Sushmita Mukherji[3], Begam Sabiha Masuda Khanam[3]

[1]Associate Professor, Department of Ophthalmology, R. G. Kar Medical College, Kolkata, West Bengal, India, [2]Assistant Professor, Department of Ophthalmology, R. G. Kar Medical College, Kolkata, West Bengal, India, [3]Postgraduate Trainee, Department of Ophthalmology, R. G. Kar Medical College, Kolkata, West Bengal, India

Abstract

Introduction: Primary acute angle closure glaucoma (PAACG) is an ophthalmic emergency and potentially blinding diseases (the distribution of ACG has shown striking differences by racial groups in individual over 40 years of age with optic nerve damage which occurs after a sudden rise of intraocular pressure associated with a PAACG episodes).

Materials and Methods: The study enrolled 30 patients with unilateral PAACG attack in the first 4 months after remission and 30 normal persons for control. Using the stratus optical coherence tomography (OCT) (Version 4.0.2) and GDx variable corneal compensation (VCC), the retinal nerve fiber layer (RNFL) thickness was assessed in both eyes within 2 weeks after PAACG and again after 4 months. As assessed by OCT and GDx VCC, RNFL thickness in subjects became thicker at 2 weeks and thinner by 4 months of acute attack compared with the fellow unaffected and normal eyes.

Results: RNFL of PAACG eyes became thicker by an average of 143.87 ± 15.23 μ compared to 108.53 ± 7.44 μ in the fellow eye and 108.90 ± 7.93 μ in the normal eye ($P < 0.001$) within 2 weeks. It became thinner by an average of 88.73 ± 10.27 μ in the affected eyes compared to 107.87 ± 7.20 μ in the fellow eyes and 107.17 ± 7.29 μ in the normal eye ($P < 0.001$) at 4 months. Significant differences were demonstrated comparing the average and four quadrant RNFL thickness for attacked eyes and those of normal control ($P < 0.001$) and fellow eyes ($P < 0.001$-0.002) using analysis of variance both within 2 weeks and at 4 months after remission.

Conclusion: Using OCT and GDx VCC, RNFL thickness was found increased in eyes immediately after an episode of PAACG followed by a decrease in RNFL thickness over time (up to 4 months). This detection can aid in better understanding of the pathological changes in the retina in PAACG and thus help in the assessment and management of these patients.

Key words: Goldmann applanation tonometry, GDx variable corneal compensation, Optical coherence tomography, Primary acute angle closure glaucoma, Retinal nerve fiber layer

INTRODUCTION

Primary acute angle closure glaucoma (PAACG) is an ophthalmic emergency and potentially blinding diseases (the distribution of ACG has shown striking differences by racial groups in individual over 40 years of age, with optic nerve damage which occurs after a sudden rise of intraocular pressure [IOP] associated with a PAACG episodes). The optic disc appears edematous during this episode and pallor with or without cupping may develop after remission. When treatment is delayed vision may reduce markedly to hand movement or light perception.[1] Pathologically, the ganglion cells die by apoptosis and their axons disappear over and above the normal apoptotic loss that occurs naturally with age. Perimetric examination during acute episodes is difficult and usually

Access this article online

www.ijss-sn.com

Month of Submission : 12-2016
Month of Peer Review : 01-2017
Month of Acceptance : 01-2017
Month of Publishing : 02-2017

Corresponding Author: Dr. Md. Nazarul Islam, 75, Dr. Biresh Guha Street, Kolkata - 700 017, West Bengal, India. Phone: +91-9433114913. E-mail: nazarul_islam24@yahoo.cpm

unreliable. After remission, visual field defect varies greatly in severity and type.[2] Measurement of retinal nerve fiber layer (RNFL) thickness loss after PAACG is very important as it is both objective and sensitive in terms of detection of optic disc damage with either normal or unreliable fields.

In recent years various glaucoma imaging modalities - optical coherence tomography (OCT), scanning laser polarimetry (SLP), confocal scanning laser ophthalmoscopy, SLP + variable corneal compensation (VCC) (GDx VCC, Carl Zeiss Meditech, Inc., Dublin, CA) in the management of glaucoma. OCT is a high-resolution glaucoma imaging device capable of obtaining reproducible RNFL thickness measurement.[3-5] This device has been shown in cross-sectional studies to allow differentiation between normal and glaucoma patient.[6-9] Studies have shown that SLP with VCC significantly improves the structure - function relationship[10,11] agreement with other imaging technologies[10,12] and discriminating power for detection for glaucoma.[13-16]

MATERIALS AND METHODS

This was a prospective observational study undertaken in a tertiary health-care center in West Bengal from March 2014 to February 2015 which was approved by institution ethics committee. A prior written consent from the participants was taken. The study population included 30 eyes of the patient with unilateral attack of PAACG, 30 fellow eyes and 30 eyes of control, patient attending ophthalmology outpatient department of same age and sex without symptoms and sign suggestive of ACG over a time period of 1 year. To be eligible patients required to have at least two of the following symptoms - ocular pain, blurred vision, headache, vomiting and presence of any of the signs like conjunctival congestion, mid dilated nonreactive pupil, corneal edema, IOP >45 mmHg, closed angle on gonioscopy, duration of PAACG attack ≤120 h and complete resolution of attack with medical therapy and surgery and IOP below 21 mm Hg after treatment. Patients were excluded if the attack was bilateral, secondary angle closure, PAACG of the fellow eye in the past, refractive error of ≥5.00 D spherical and or 3.0 D cylindrical, persistent corneal edema or opacity after PAACG attack, previous intraocular surgery or intraocular disease that may result in abnormal RNFL thickness. OCT and GDx VCC were done once at 2 weeks and an interval of 4 months. The parameters studied were the global RNFL thickness and four quadrant RNFL thickness. Each subject underwent a comprehensive ophthalmological examination including best corrected visual acuity, IOP by Goldmann applanation tonometry, Slitlamp Biomicroscopy, Gonioscopy, Fundus evaluation on slit lamp with +90 D lens, standard achromatic perimetry on Humphrey Field Analyzer using 30-2 testing protocol by Swedish interactive threshold algorithm standard protocol. $P < 0.05$ was considered as significant.

RESULTS

A total of 30 patients and 30 controls with the same sex ratio with age group between 25 and 65 years were studied (Table 1). The mean duration of the PAACG attack was 72 ± 48 h. The global and four quadrant RNFL thickness as measured by OCT and GDx VCC showed a statistically significant difference between the eyes with acute attack and fellow or normal eye ($P < 0.001$) at 2 weeks - Table 2. These parameters also changed significantly within 4 months in eyes suffering from the acute attack. The statistical analysis was done by one-way analysis of variance. The average and (four quadrants) RNFL thickness in the eyes suffering from PAACG attack increased to 143.87±15.23 μ compared to 108.53±7.44 μ of the unaffected fellow eyes at 2 weeks ($P < 0.001$). The four quadrants RNFL also increased in the affected eyes at 2 weeks but not in the fellow eyes. At 4 months of follow-up also the four quadrant RNFL thickness decreased in the affected eye compared to the fellow eyes or normal eyes ($P < 0.001$)

Table 1: Characteristics of study population

Characteristics	*n*=30		
	Affected eyes	Unaffected eyes	Controls
Age	45±20	46±18	46±13
IOP	42±3.6	13±3.9	12±2.8
Visual field			
MD	−6.4±3.2	−1.87±0.88	−1.56±0.56
PSD	3.87±2.22	2.22±1.08	1.67±0.89

IOP: Intraocular pressure, MD: Mean deviation, PSD: Pattern standard deviation

Table 2: The global and four quadrant RNFL thickness as measured by OCT and GDx VCC

Parameters	Affected eyes±SD	Fellow eyes±SD	Control eyes±SD	*P* value
Average thickness				
Within 2 weeks	143.87±15.23	108.53±7.44	108.90±7.93	<0.001
At 4 months	88.73±10.27	107.87±7.20	107.17±7.29	<0.001
Superior quadrant				
Within 2 weeks	173.00±23.51	131.97±12.77	132.57±12.54	<0.001
At 4 months	101.43±21.29	131.17±12.74	129.93±12.35	<0.001
Nasal quadrant				
Within 2 weeks	112.77±21.83	83.87±13.44	83.27±12.92	<0.001
At 4 months	68.40±15.98	82.83±14.05	84.50±13.68	<0.001
Inferior quadrant				
Within 2 weeks	196.13±25.17	149.77±12.60	146.90±14.39	<0.001
At 4 months	110.03±26.96	150.00±12.90	147.77±13.71	<0.001
Temporal quadrant				
Within 2 weeks	96.03±25.83	71.70±9.65	73.10±10.64	<0.001
At 4 months	64.00±10.31	74.43±10.83	75.40±11.75	<0.001

RNFL: Retinal nerve fiber layer, OCT: Optical coherence tomography, SD: Standard deviation, VCC: Variable corneal compensation

vide Table 2. Therefore, we conclude that there is an initial increased in global RNFL thickness after an acute attack followed by a decrease around 4 months.

The average, temporal, superior, nasal and inferior peripapillary RNFL thickness as measured by OCT and GDx showed a statistically significant difference between the eyes with acute attack and fellow or normal eyes, respectively ($P < 0.001$).

DISCUSSION

In our study, the possible explanation for the increased global average and four quadrant RNFL thicknesses at 2 weeks is the apparent edema of the Optic Nerve Head (ONH) after a PAACG attack persisting up to 2 weeks after onset in spite of remission. Tso and Fine[18] also found from histopathology that the peripapillary RNFL thickness increased in patient with optic disc edema. Yoles and Schwart[19] have suggested a mechanism whereby glaucomatous neuropathy continues to progress even after alleviation of the high IOP.

In this study, we find that the RNFL thickness in the affected eyes correlates with the interval of follow-up of PAACG. We find that there is a rapid thinning of RNFL and gradual stabilization thereafter. This suggests that a longitudinal follow-up to detect changes in RNFL thickness is not only necessary to assess the actual loss and damage but also provides more information. The average and four quadrant RNFL thicknesses after the acute attack decreased in the affected eyes but not in the fellow eyes during the 4-month follow-up and an average and four quadrants RNFL thickness for the affected eyes correlated strongly with interval of follow-up, according to inverse regression analysis in this study.

The main limitation of the study was a relatively small sample size and limited number of the patient with less severe PAACG episodes (<48 h).

CONCLUSION

Results of this intereye and intertest comparison of RNFL thickness after a single unilateral PAACG attack using Stratus OCT and GDx VCC demonstrated an initial increase in diffuse RNFL thickness followed by a decrease. The interval between the episodes and measurement influences the result of RNFL thickness assessment. It thus appears reasonable to suggest that longitudinal follow-up must be considered in any comprehensive study of the long-term effect of PAACG.

REFERENCES

1. Douglas GR, Drance SM, Schulzer M. The visual field and nerve head in angle-closure glaucoma. A comparison of the effects of acute and chronic angle closure. Arch Ophthalmol 1975;93:409-11.
2. Bonomi L, Marraffa M, Marchini G, Canali N. Perimetric defects after a single acute angle-closure glaucoma attack. Graefes Arch Clin Exp Ophthalmol 1999;237:908-14.
3. Huang D, Swanson EA, Lin CP, Schuman JS, Stinson WG, Chang W, *et al.* Optical coherence tomography. Science 1991;254:1178-81.
4. Schuman JS, Pedut-Kloizman T, Hertzmark E, Hee MR, Wilkins JR, Coker JG, *et al.* Reproducibility of nerve fiber layer thickness measurements using optical coherence tomography. Ophthalmology 1996;103:1889-98.
5. Blumenthal EZ, Williams JM, Weinreb RN, Girkin CA, Berry CC, Zangwill LM. Reproducibility of nerve fiber layer thickness measurements by use of optical coherence tomography. Ophthalmology 2000;107:2278-82.
6. Schuman JS, Hee MR, Puliafito CA, Wong C, Pedut-Kloizman T, Lin CP, *et al.* Quantification of nerve fiber layer thickness in normal and glaucomatous eyes using optical coherence tomography. Arch Ophthalmol 1995;113:586-96.
7. Bowd C, Zangwill LM, Berry CC, Blumenthal EZ, Vasile C, Sanchez-Galeana C, *et al.* Detecting early glaucoma by assessment of retinal nerve fiber layer thickness and visual function. Invest Ophthalmol Vis Sci 2001;42:1993-2003.
8. Mistlberger A, Liebmann JM, Greenfield DS, Pons ME, Hoh ST, Ishikawa H, *et al.* Heidelberg retina tomography and optical coherence tomography in normal, ocular-hypertensive, and glaucomatous eyes. Ophthalmology 1999;106:2027-32.
9. 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;135:513-20.
10. Bagga H, Greenfield DS, Feuer W, Knighton RW. Scanning laser polarimetry with variable corneal compensation and optical coherence tomography in normal and glaucomatous eyes. Am J Ophthalmol 2003;135:521-9.
11. Reus NJ, Lemij HG. The relationship between standard automated perimetry and GDx VCC measurements. Invest Ophthalmol Vis Sci 2004;45:840-5.
12. Essock EA, Sinai MJ, Bowd C, Zangwill LM, Weinreb RN. Fourier analysis of optical coherence tomography and scanning laser polarimetry retinal nerve fiber layer measurements in the diagnosis of glaucoma. Arch Ophthalmol 2003;121:1238-45.
13. Choplin NT, Zhou Q, Knighton RW. Effect of individualized compensation for anterior segment birefringence on retinal nerve fibre layer assessment as determined by scanning laser polarimetry. Ophthalmology 2000;110:719-25.
14. Weinreb RN, Bowd C, Zangwill LM. Glaucoma detection using scanning laser polarimetry with variable corneal polarization compensation. Arch Ophthalmol 2003;121:218-24.
15. Bagga H, Greenfield DS, Feuer W. Quantitative assessment of atypical birefringence images using scanning laser polarimetry with variable corneal compensation. Am J Ophthalmol 2005;139:437-46.
16. Toth M, Hollo G. Enhanced corneal compensation for scanning laser polarimetry on eyes with atypical polarization pattern. Br J Ophthalmol 2005;89:1139-42.
17. Tsai JC. Optical coherence tomography measurement of retinal nerve fibre layer after acute primary angle closure with normal visual field. Am J Ophthalmol 2006;113:924-9.
18. Tso MO, Fine BS. Electron microscopic study of human papilledema. Am J Ophthalmol 1976;82:294-98.
19. Yoles E, Schwart Z. Potential neuroprotective therapy for glaucomatous optic neuropathy Surv Ophthalmol 1998;42:367-72.

How to cite this article: Islam MN, Saha M, Chowdhury D, Mukherji S, Khanam BSM. Role of Optical Coherence Tomography and Scanning Laser Polarimetry (GDx Variable Corneal Compensation) in the Assessment of Retinal Nerve Fiber Layer in Primary Acute Angle Closure Glaucoma. Int J Sci Stud 2017;4(11):74-76.

Source of Support: Nil, **Conflict of Interest:** None declared.