

Evaluation of Color Vision in Patients with Glaucoma Suspect

Ratu Windi Meidiana¹, Masitha Dewi Sari²

¹Ophthalmology resident, Department of Ophthalmology, University of Sumatera Utara, Indonesia

²Ophthalmologist, Department of Ophthalmology, University of Sumatera Utara, Indonesia

Abstract: ***Purpose:** To assess color vision deficiency in patient with glaucoma suspect. **Methods:** A total of 75 eyes (39 patients) with glaucoma suspect and Primary Open Angle Glaucoma as a control who fulfilled the inclusion/exclusion criteria were enrolled this observational analytic with a cross sectional study. Color vision deficiency was assessed using Farnsworth Munsell D-15 test. Retinal nerve fiber layer thickness was performed with Spectral Domain-Optical Coherence Tomography. **Result:** 38/41 eyes with glaucoma suspect had no color vision deficiency; 2 eyes manifested a tritan color vision defect; and 1 eye manifested a protan color vision defect. There were no statistical correlation between glaucoma suspect and color vision deficiency. And there were no correlation between changes in RNFL thickness and the occurrence of color vision in patient with glaucoma suspect. **Conclusion:** Color vision deficiency tend to occur in patient with Primary Open Angle Glaucoma ($p=0.059$) compared to those with glaucoma suspects ($p=0.344$) in the correlation with Retinal Nerve Fiber Layer thickness.*

Keywords: color vision deficiency, glaucoma suspect, retinal nerve fiber layer.

1. Introduction

Glaucoma suspect as an individual who has minimal one of the following criteria. An individual might lead being classified as a glaucoma suspect, if there is minimal one of the following criteria, such as:^{1,2}

- A suspicious optic disc or retinal nerve fiber layer (RNFL) on examination with glaucomatous damage appearance
- A consistently high pressure of intraoculi with normal appearance of optic disc and RNFL, without visual field dysfunction
- A visual field abnormalities with glaucomatous damage appearance

Color vision deficiency is an inability to discriminate differences in color by the wavelength. The acquired color vision deficiency (ACVD) may occurs due to ocular disease, neurological abnormalities or drug toxicity. Recent studies denote that ACVD may occur in early glaucoma, and it affects the blue yellow spectrum rather than red green spectrum.^{3,4,5}

A study has found a high prevalence of ACVD with Primary Open Angle Glaucoma (POAG). Color vision deficiency can occur before glaucomatous damage and can be one of predictive factor of glaucoma progression.⁶ In our study, we evaluated the color vision in patients with glaucoma suspect.

2. Method

Subjects

This observational analytic with cross sectional study comprised 39 patients (75 eyes) with glaucoma suspect and POAG as a control were evaluated color vision test using Farnsworth Munsell D15 test. This subjects were recruited at Glaucoma Department, University of Sumatera Utara Hospital from January to March 2019. The study has been

approved by the Ethics Committee of the Faculty of Medicine, University of Sumatera Utara.

We performed ophthalmic examination, including best corrected visual acuity (BCVA), intraocular pressure, slit lamp examination, iridocorneal angle with gonioscopic (Volk Optical, Germany), RNFL thickness with SD OCT (Optovue), Farnsworth Munsell D15.

Inclusion criteria:

- Patient with glaucoma suspect ≥ 18 years old
- Patient with POAG ≥ 18 years old
- Approved the consent form

Exclusion criteria:

- Congenital color deficiency
- Any abnormalities of refraction media
- Optic neuritis
- Taking medication of tuberculosis drugs, antiepileptic drugs, digoxin or any other medication known associated with color vision deficiency

Statistical Analysis

The data collected in tabulation form which then performed analytical statistic technique using the non parametric test type *Chi-Square* and *Fisher's Exact* test.

3. Result

This study was conducted at University of Sumatera Utara Hospital from Januari to March 2019. The subjects were patients with glaucoma suspects (41 eyes) and patients with POAG (34 eyes) as a control.

Table 1: Subject Characteristics

Characteristics	Total	%
Age		
17 – 25 years old	17	22.7
26 – 35 years old	16	21.3
36 – 45 years old	32	42.7
46 – 55 years old	10	13.3
Visual Acuity		
6/4 – 6/7,5	35	46.7
6/10 – 6/18	26	34.7
6/24 – 6/48	2	2.7
6/60 - 3/60	12	16
Intraocular Pressure		
10 – 21 mmHg	62	82.7
>21 mmHg	13	17.3
CDR		
< 0,3 mm	11	14.7
0,3 – 0,5 mm	24	32
0,6 - 0,7 mm	36	48
0,8 – 1,0 mm	4	5.3
RNFL		
Normal	61	81.3
Borderline	5	6.7
Outside normal	9	12
Diagnosis		
Glaucoma suspects	41	54.7
POAG	34	45.3

Table 2: Characteristics of Acquired Color Vision Deficiency and its Severity

	Diagnosis	
	Glaucoma Suspect n (%)	POAG n (%)
Color Vision Deficiency Type		
Not Color Blind	38 (92.7%)	26 (76.5%)
Protan	1 (2.4%)	4 (11.8%)
Deutan	0 (0.0%)	1 (2.9%)
Tritan	2 (4.9%)	3 (8.8%)
Severity		
Normal	38 (92.7%)	28 (76.5%)
Slightly	3 (7.3%)	7 (20.6%)
Moderate	0 (0.0%)	1 (2.9%)

Table 3: Correlation between Visual Acuity and Diagnosis

Visual Acuity	Diagnosis				Total	
	Glaucoma Suspect		POAG			
	n	%	n	%	n	%
Normal Vision	22	62.9	13	37.1	35	100.0
Mild Visual impairment (Near Normal Vision)	14	53.7	12	46.2	26	100.0
Moderate Visual Impairment	1	50.0	1	50.0	2	100.0
Severe Visual Impairment	4	33.3	8	66.7	12	100.0
Total	41	54.7	34	45.3	75	100.0

Table 4: Correlation between Diagnosis and Color Vision

Visual Acuity	Diagnosis				Total		p.
	Glaucoma Suspect		POAG				
	n	%	n	%	n	%	
Not Color Blind	38	59.4	26	40.6	64	100.0	0.058
Color Blind	3	27.3	8	72.7	11	100.0	
Total	41	54.7	34	45.3	75	100.0	

From the table 4, result from Fisher’s Exact test show that there was no correlation between glaucoma suspect with color vision deficiency.

Table 5: Correlation between Color Vision Deficiency and RNFL Thickness

Diagnosis	RNFL	Not Color Blind	Color Blind	p.
		n (%)	n (%)	
Glaucoma Suspect	Normal	33 (86.8)	2 (66.7)	0,344
	Borderline	3 (7.9)	1 (33.3)	
	Outside Normal	2 (5.3)	0 (0.0)	
	Total	38 (100.0)	3 (100.0)	
POAG	Normal	22 (84.6)	4 (50.0)	0,059
	Borderline	0 (0.0)	1 (12.5)	
	Outside Normal	4 (15.4)	3 (37.5)	
	Total	26 (100.0)	8 (100.0)	

Table 5 showed the correlation between color vision deficiency with RNFL thickness in OCT. Color vision deficiency tend to occur in patient with POAG (p=0.059) compared to those with glaucoma suspects (p=0.344) in the correlation with RNFL thickness.

4. Discussion

The result of this study different with study from Lakowski and Drance (20% ocular hypertension had correlation with CVD on severity of CVD (*severe*)). Study from Dimitris P, et al 2009 found that there is significant correlation between CVD with ocular hypertension and POAG. Other study by Vu Anh Tuan, et al 2017 show that *acquired color vision deficiency* occurs in ocular hypertension and glaucoma.^{4,7,8}

From the correlation table between glaucoma suspect with POAG on CVD (p = 0.058) show insignificant differences between glaucoma suspect and POAG on CVD. The same study was conducted by Maria P Bambo, et al from the year 2016 in Spanyol shows that insignificant correlation between *early glaucoma* dan *moderate glaucoma group* on *color vision test*.⁹

From the table correlation between RNFL with CVD show that insignificant correlation differences between RNFL with CVD on glaucoma suspect (p = 0.344) and POAG (p= 0.059), but color vision deficiency tend to occur in patient with POAG (p=0.059) compared to those with glaucoma suspects (p=0.344) in the correlation with RNFL thickness.

The same study was conducted by Juhani Airaksinen, et al from the year 1986 in Kanada and Vu Anh-Tuan, et al from the year 2017 in Vietnam shows that no significant correlation between localized RNFL with CVD.^{4,10}

5. Conclusion

Color vision deficiency tend to occur in patient with POAG compare to those with glaucoma suspect in correlation with RNFL.

References

- [1] Cantor LB, Rapuano CJ, Cioffi GA, editors. Open-Angle Glaucoma. American Academy of Ophthalmology The Eye M.D. Association Glaucoma 10th Section. Sanfransisco: LEO;2016. p.80
- [2] Tuli D. Glaucoma Suspect. Journal of Current Glaucoma Practice. 2011; 5(3): 5-11.
- [3] Khurana AK. Physiology of Eye and Vision. In : Khurana AK, editor. Comprehensive Ophthalmology. 4thed. New Age International. New Delhi. 2007. p17-18.
- [4] Tuan VA, Hoang-Dhuong P, Trong-Van P, Huu-Phuong N. Acquired Color Vision Deficiency in Vietnamese Patients with Primary Open Angle Glaucoma. Eye SEA. 2017; 12(2): 29-35.
- [5] Hasrood N, Rubin A. Defect of colour vision: A review of congenital and acquired colour vision deficiencies. 2016; 75(1): 1-6.
- [6] Cutillas MP, Sahraie A, Edgar FD. Acquired Color Vision Defect in Glaucoma-their Detection and Clinical Significant. Br J Ophthalmol. 1999; 83: 1396-1402.
- [7] Lakowski R and Drance SM. Acquired dyschromatopsias: the earliest functional losses in glaucoma. Doc Ophthalmol Proc Ser; 1978;19. p305.
- [8] Papaconstantinou D, Georgalas I, Kalantzis G, et al. Acquired colour vision and visual field defects in patients with ocular hypertension and early glaucoma. Clin Ophthalmol. 2009;3:251-257
- [9] Bamboo MP, et al. Evaluation of Contrast Sensitivity, Chromatic Vision, and Reading Ability in Patiets with Primary Open Angle Glaucoma. Journal of Ophthalmology; 2016;p1-6.
- [10] Airaksinen PJ, et al. Color vision and Retinal Nerve Fiber Layer in Early Glaucoma. American Journal of Ophthalmology; 1986

Author Profile

Ratu Windi Meidiana, Ophthalmology resident, Department of Ophthalmology, University of Sumatera Utara, Indonesia

Masitha Dewi Sari, Ophthalmologist, Department of Ophthalmology, University of Sumatera Utara, Indonesia