



COMPARISON OF CENTRAL CORNEAL THICKNESS IN OCULAR HYPERTENSION, NORMAL TENSION GLAUCOMA, AND PRIMARY OPEN ANGLE GLAUCOMA

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ARTICLE INFO

Article History:

Received 4th October, 2019

Received in revised form 25th

November, 2019

Accepted 23rd December, 2019

Published online 28th January, 2020

Key words:

Central corneal thickness, ocular hypertension, normal tension glaucoma, primary open angle glaucoma

ABSTRACT

Purpose: To compare the central corneal thickness of ocular hypertension, normal tension glaucoma, and primary open angle glaucoma.

Methods: An analytical observational with cross-sectional methods were analyzed. The samples in this study were ocular hypertension, normal tension glaucoma, and primary open angle glaucoma at Universitas Sumatera Utara Hospital and networking hospital. Central corneal thickness was measured on 106 eyes with OCT Optovue®.

Results: A total of 106 eyes, with characteristic by age 44.98 ± 16.941 years, which female 62.1% and male 37.9%. The subjects of ocular hypertension were found 33.0%, normal tension glaucoma 32.1%, and primary open angle glaucoma 34.9%. The central corneal thickness was significant differences ($p=0.0001$) in this study.

Conclusion: Central corneal thickness was significant in ocular hypertension, normal tension glaucoma, and primary open angle glaucoma.

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INTRODUCTION

Glaucoma is a collection of symptoms with the characteristics of optic neuropathy which is characterized by the closure of optic disc cupping with impaired visual function in the form of a narrowing of the visual field. In most individuals with glaucoma, optic nerve abnormalities and visual field determined by high intraocular pressure and resistance of the optic nerve to become damaged. Although progressive changes in the optic nerve and visual field associated with increased intraocular pressure, sometimes glaucoma intraocular pressure is within normal limits.¹

Primary open angle glaucoma is the most common type of glaucoma, in the United States, the incidence rate above 40 years reaches 1.86% and causes blindness in 12.3% of all blindness cases. WHO states the incidence of primary open angle glaucoma in the world around 2.4 million people per year, around 8 million people experience blindness were 4 million of them caused by primary open angle glaucoma.¹

According to the 1993-1996 Sensory Health Survey, around 1.5% of Indonesia's population experienced blindness, where the prevalence of blindness for glaucoma was 0.20%, while the prevalence of glaucoma according to the Jakarta Urban Eye Health Study in 2008, the prevalence of primary angle closure

glaucoma was of 1.89%, primary open angle glaucoma 0.48% and secondary glaucoma of 0.16%.² Based on the Basic Health Research (Riskesmas) data in 2007, the national glaucoma incidence rate in Indonesia reached 0.46%.³

The number of primary open angle glaucoma sufferers estimated to reach 58.6 million in the world in 2020, with the number of primary angle closure glaucoma sufferers 21 million.^{4,5} Primary open angle glaucoma is glaucoma accompanied by an increase in IOP above 21 mmHg, with the corner of the eye chamber open. Normal tension glaucoma is a variant of open angle glaucoma.⁵

Central corneal thickness is an important indicator in assessing the condition of the cornea, especially endothelial pump function. Physicians use it in refractive surgery and are one of the important variables in determining the intraocular pressure of glaucoma patients and suspects of glaucoma.⁶

The thickness of the cornea varies from the center to the limbus, the thinnest zone is 1.5mm temporally from the central, and becomes thicker in the paracentral and peripheral regions. Corneal thickness ranges from 700 to 900 μm in the limbus and around 540-550 μm in the center. The central corneal thickness of 700 μm or more shows endothelial compensation. The average thickness of the central cornea as shown by various studies is the 510-520 μm (standard deviation 0.02-0.04) or about 540 μm .⁷

In a study conducted by Copt et al. (1999), misdiagnosed in patients with primary open angle glaucoma with thin corneal

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thickness diagnosed as normal tension glaucoma and treated as normal tension glaucoma.⁸

Choliq (2011) states that intraocular pressure influenced by the average thickness of the central cornea, the average thickness of the central cornea in primary open angle glaucoma differs from normal tension glaucoma at the age above 60 years and the difference in the mean thickness of the central cornea in normal tension glaucoma and ocular hypertension.⁹

Anupama (2013) states that the thickness of the central cornea in normal tension glaucoma is thinner than primary open angle glaucoma, where the thickness of the central cornea in ocular hypertension is thinner than normal tension glaucoma.¹⁰

MATERIALS AND METHODS

This research is an analytic observational with a cross-sectional method of collecting data. We carried no treatment out on the research subjects and one-time data taking. We conduct the study at the Ophthalmology clinics of the Universitas Sumatera Utara Hospital and networking hospital around Medan from June 2019.

The study population was all patients with ocular hypertension, normal tension glaucoma, and primary open-angle glaucoma. The study sample is taken and determined based on the number of patients with ocular hypertension, normal tension glaucoma, and primary open angle glaucoma that met the inclusion criteria.

Inclusion Criteria Patients with ocular hypertension, normal tension glaucoma, and primary open angle glaucoma >18 years old. Exclusion Criteria are Patients with anterior segment abnormalities, Patients with a history of cataract surgery less than 1 month, and Patients who are not cooperative.

In subjects who meet the inclusion criteria will fill out the bio-data sheet and sign the Informed Consent letter, do a visual examination with Snellen Chart, do an intraocular pressure examination with a Schiottz Tonometer, do an anterior segment examination with the Righton Slit Lamp, do an eyepiece angle examination with Gonio Lens Sussman 3-mirror, Performed posterior segment examination with Ophthalmoscopy Direct Neitz®, Examined central corneal thickness using SD-OCT Optovue Ivue Scanner.

This research was first approved by the Department of Eye Health Sciences, Faculty of Medicine, Universitas Sumatera Utara. We then submitted this research was then for approval by the ethics committee at the Faculty of Medicine, Universitas Sumatera Utara.

The description of the research variable made in the form of tabulated data and described. Comparative data of central corneal thickness in patients with ocular hypertension, normal tension glaucoma, and primary open angle glaucoma will be processed with the Anova test if we found normally distributed data.

RESULT

We took the study subjects as a study sample after meeting the inclusion criteria and got 106 eyes. Subjects were patients with ocular hypertension, normal tension glaucoma, and primary open angle glaucoma.

Table 1 General Characteristics of Research Subjects

Characteristics	Total	%
Gender		
Male	22 people	37.9
Female	36 people	62.1
Age		
18-40 year old	25 people	43.1
>40-60 year old	20 people	34.5
>60 year old	13 people	22.4
Lateralization		
Unilateral	10 people	17.2
Bilateral	48 people	82.8
Intraocular Pressure		
10-21mmHg	36 eyes	33.9
>21mmHg	70 eyes	66.1
Diagnosis		
Ocular hypertension	35 eyes	33.0
Normal tension glaucoma	34 eyes	32.1
Primary open angle glaucoma	37 eyes	34.9

Table 2 shows that patients with ocular hypertension have an average age of 40.84 ± 16,433 years where the minimum age is 19 years and the maximum age is 76 years. In patients with normal tension glaucoma found an average age of 46.35 ± 17,194 years with a minimum age of 23 years and a maximum age of 71 years. Whereas in patients with primary open angle glaucoma found an average age of 47.50 ± 17,281 years with a minimum age of 22 years and a maximum age of 76 years.

Table 2 Age comparison of subjects based on diagnosis

Diagnosis	Age					P
	n	Mean	Std. Deviation	Minimum	Maximum	
Ocular hypertension	19	40.84	16.433	19	76	0.428
Normal tension glaucoma	17	46.35	17.194	23	71	
Primary open angle glaucoma	22	47.50	17.281	22	76	

Table 3 Comparison of central corneal thickness to gender

Gender	Central corneal thickness			P
	n	Mean	Std. Deviation	
Male	22	532.36	32.604	0.143
Female	36	520.75	26.349	

From table 3 we found that the average value of central corneal thickness has no difference for males and females.

Table 4 Comparison of central corneal thickness to age

Age	Central corneal thickness			P
	n	Mean	Std. Deviation	
18-40 year old	25	520.76	32.758	0,366
>40-60 year old	20	524.30	25.590	
>60 year old	13	534.92	26.660	

From table 4 we found that the average value of central corneal thickness does not have a significant difference based on the age of the subject.

Table 5 Comparison of central corneal thickness to lateralization

Lateralization	Central corneal thickness			P
	n	Mean	Std. Deviation	
Unilateral	10	527.00	31.404	0.828
Bilateral	48	524.77	29.007	

Table 5 shows that the mean value of central corneal thickness has no difference in subjects with unilateral and bilateral diagnoses.

Table 6 Comparison of central corneal thickness to intraocular pressure

Intraocular Pressure	Central corneal thickness			P
	n	Mean	Std. Deviation	
10-21mmHg	36	524.19	16.782	0.922
>21mmHg	70	524.77	33.073	

Table 6 shows that the mean value of central corneal thickness does not have a significant difference in intraocular pressure.

Table 7 Comparison of central corneal thickness in subjects

Diagnosis	n	Central corneal thickness			P
		Mini-mum	Maxi-mum	Mean	
Ocular hypertension	35	458	534	500.09	0.0001
Normal tension glaucoma	34	489	557	524.06	
Primary open angle glaucoma	37	504	610	548.22	

Table 7 shows a significance value of 0.0001 (p <0.05) which shows that there are differences in the central cornea thickness in patients with ocular hypertension, normal tension glaucoma, and primary open-angle glaucoma.

DISCUSSION

Table 1 shows that most subjects were women by 36 people. Table 3 shows male subjects having an average central corneal thickness of $532.36 \pm 32.604 \mu\text{m}$ and for female sex having an average central corneal thickness of $520.75 \pm 26.349 \mu\text{m}$. This explains that women in the study subjects were in greater numbers and thinner corneal thickness compared to men.

This is in line with Saulius study in 2014 which explained that female sex has a thinner thickness of the central cornea compared to men. It also explained that there were no significant differences between sex characteristics and the thickness of the central cornea.¹¹

Table 1 describes the general characteristics of the study subjects and in patients with ocular hypertension, normal tension glaucoma, and most primary open angle glaucoma at 18-40 years. In table 2, we found that the youngest age in the subject is 19 years old who is a patient of ocular hypertension, and the oldest age is 76 years found in patients with ocular hypertension and primary open-angle glaucoma.

This is not in line with research conducted by Krishnan et al. in India that the average age of patients with open angle glaucoma is 51.75 years.¹² In the study of Choliq et al. in Surabaya stated that the average age of patients with ocular hypertension is younger than those with normal tension glaucoma and primary open angle glaucoma, wherein his study it stated that the average age was 60.50 ± 12.69 .⁹ Besides, the results were also not in line with the study conducted by Shih et al. in 2004 which stated that subject subjects had an average age of 71.4 ± 13.8 year.¹³

Table 1 also explains lateralization that is more affected is bilateral, more intraocular pressure at pressures greater than 21 mmHg because the subjects of this study are more in patients with ocular hypertension and primary open angle glaucoma. It

was also explained that the primary open angle glaucoma sufferers became the most subjects in this study 37 eyes.

In tables 4, 5, and 6 we have explained that there were no significant differences in the central corneal thickness to the characteristics of patients in this study, both in the characteristics of age, lateralization, and intraocular pressure.

This is in line with research conducted by Reza in Iran in 2017 which explains that there is no difference in the central corneal thickness to age, sex, and other systemic factors.¹⁴ In that study explained that the range of young age has a thicker corneal thickness compared to old age. But it is not in line with the characteristics of intraocular pressure wherein the study showed the thickness of the central cornea has a significant difference to the intraocular pressure.¹⁴

Table 7 shows that the mean value of central corneal thickness in ocular hypertension has the thinnest average when compared with the central corneal thickness in patients with normal tension glaucoma and primary open-angle glaucoma. The table also shows that patients with normal tension glaucoma have a thinner thickness of the central cornea compared with patients with primary open angle glaucoma.

This is not in line with research conducted by Yagci et al. in Turkey in 2005 also found that the thickness of the central cornea is thicker in patients with ocular hypertension compared with patients with primary open angle glaucoma.¹⁵ Leon study in 2004 stated that thinner central corneal thickness is one of the main risk factors for a more progressive open angle glaucoma.¹⁶

Table 7 explains that there are significant differences in the central cornea thickness of patients with ocular hypertension, normal tension glaucoma, and primary open angle glaucoma. This is in line with research conducted by Anupama in 2013 that the central cornea thickness in normal tension glaucoma is thinner than primary open-angle glaucoma, where the central corneal thickness in ocular hypertension is thinner than normal tension glaucoma.¹⁰

This is also in line with research conducted by Mrunal in 2017 which states that there is a significant difference between the central corneal thickness in subjects with normal tension glaucoma and patients with ocular hypertension and primary open angle glaucoma. But the results showed that patients with ocular hypertension had a thicker central corneal thickness.¹⁷ This is not in line with a study conducted by Ventura in 2001, found that the central corneal thickness in patients with ocular hypertension is thicker when compared with patients with normal tension glaucoma, and patients with normal tension glaucoma have a thicker central corneal thickness when compared with primary open angle glaucoma sufferers.¹⁸

CONCLUSION

In this study, there were significant differences in the central cornea thickness in patients with ocular hypertension, normal tension glaucoma, and primary open angle glaucoma. In which the results showed that ocular hypertension have a thinner thickness of the central cornea than patients with normal tension glaucoma and primary open angle glaucoma. So that necessary counseling and education to patients and families of patients to be more aware of the incidence of glaucoma that is more progressive. Screening of the patient's family needed,

especially in patients with hypertension ocular which have a thinner central corneal thickness.

Acknowledgment

The authors are deeply indebted to the Faculty of Medicine, Universitas Sumatera Utara for providing equipment and scientific apparatus.

Conflict of Interest

the authors declare that there are no conflicts of interest.

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How to cite this article:

Rafika Rahman and Masitha Dewi Sari (2020) 'Comparison of Central Corneal Thickness in Ocular Hypertension, Normal Tension Glaucoma, and Primary Open Angle Glaucoma', *International Journal of Current Advanced Research*, 09(01), pp. 20954-20957. DOI: <http://dx.doi.org/10.24327/ijcar.2020.20957.4106>
