Choroidal Thickness Evaluation in Central Serous Chorioretinopathy at Thammasat University Hospital

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Purpose: To establish a normative database of subfoveal choroidal thickness (CT) in normal eyes compared with central serous chorioretinopathy eyes (CSC) by using enhanced depth-imaging optical coherence tomography.

Method: This cross-sectional, observational study was carried out on outpatients recruited from the Department of Ophthalmology, Faculty of Medicine, Thammasat University Hospital, Thailand, from November 2018 to June 2019. A total of 30 patients (30 eyes) was included (15 normal eyes of healthy patients, 15 central serous chorioretinopathy eyes). Subfoveal choroidal thickness was measured by enhanced depth-imaging optical coherence tomography. Subjects with systemic diseases and ocular diseases that may affect the choroidal vascular blood vessels were excluded.

Results: In CSC eyes, mean subfoveal choroidal thickness was 390.96 ± 55.12 μm with a mean age of 46.13 ± 10.70 years old. 86.67% was male. In normal eyes, mean osubfoveal choroidal thickness was 250.69 ± 69.95 μm with a mean age of 60.07 ± 11.91 years old, 46.67% were male. Baseline axial length, autorefraction and BCVA showed no difference between two groups. Subgroup analysis of choroidal thickness in different age groups showed the mean of subfoveal choroidal thickness in CSC eyes was thicker than normal eyes in every age group. The age groups of 41-50, 61-70 and 71-80, subfoveal choroidal thickness in CSC eyes was thicker than normal eyes with statistical significance.

Conclusion: The mean subfoveal choroidal thickness in CSC eyes was thicker than normal eyes significantly.

Keywords: choroidal thickness, central serous chorioretinopathy, enhanced depth-imaging optical coherence tomography

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Background

The term Pachychoroid firstly introduced by Warrow et al. in 2013 to describe a group of macular diseases presenting with a thick choroid.[1] Central serous chorioretinopathy (CSC) is one of the diseases that can present with a thick choroid.[2] CSC is a disorder characterized by serous retinal detachment and/or retinal pigment epithelial (RPE) detachment. It is a common cause of vision-threateningretinopathies occurring incidentally after age-related macular degeneration, macular edema from diabetic retinopathy and branch retinal vein occlusion.[3] The prevalence of CSC is higher in men, about 72-88% of cases occurring in male subjects.[4] CSC is less common in African Americans

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when compared with Caucasians, Hispanics, and Asians.[5-7]

Since spectral domain OCT device (SD-OCT) was approved by the FDA in 2006, it has become the standard for imaging because it has the ability to image the retina and ocular structure rapidly. The most clinically useful application of SD-OCT in CSC has been the ability to image the choroid with enhanced depth imaging (EDI-OCT), the sensitivity of the choroidal imaging is enhanced and the images are clearer. In CSC, the choroid has been shown to be abnormally thick in both the affected and the fellow eye.[8, 9]

Although choroidal thickness in CSC have been reported in several studies, it has not been reported in the Thai population.[9-15] The aim of this study is to establish a normative database of subfoveal choroidal thickness in central serous chorioretinopathy eyes comparing with normal eyes in Thai population by using enhanced depth-imaging optical coherence tomography.

Material and methods

This study was approved for ethical research in humans with the human research ethics committee of Thammasat university, Thailand (Research ID: MTU-EC-OP-1-243/61).

This was a cross-sectional, observational study. Bilateral eyes of 30 outpatients, aged 20-80 years from Department of Ophthalmology, Faculty of Medicine, Thammasat University Hospital, Thailand, from November 2018 to June 2019, were recruited for this study. A total of 30 patients was included (15 normal eyes of healthy patients, 15 central serous chorioretinopathy eyes).

Patient selection

Inclusion criteria

Inclusion for normal eyes

1. Patients aged 20-80 years.
2. Patients with UCVA better than 20/40 or 0.3 logMAR score
3. Eyes with normal anterior chamber and fundus examination.
4. Patients were informed and consented to enroll in the study.

Inclusion criteria for central serous chorioretinopathy eyes

1. Patients aged 20-80 years.
2. Eyes diagnosed CSC with duration of symptoms of 1-4 months including single angiographic leakage at subfoveal or juxtafoveal location with a neurosensory detachment.
3. Naive eyes with no previous treatment
4. Patients informed and consented to enroll in the study.

Exclusion criteria

1. Patients with axial length < 23.0 mm. or > 24.5 mm.
2. Patients with refractive error > ± 2.00 diopter spherical equivalent.
3. Patients with intraocular pressure > 21.0 mmHg.
4. Eyes with cataract that would obscure an image capture of high quality.
5. Patients with systemic diseases that may affect the choroidal vascular blood vessels such as diabetes mellitus, hypertension, heart disease, or hyperlipidemia.
6. Patients who with evidence of any ocular diseases such as uveitis, glaucoma, amblyopia, strabismus, retinal degeneration, proliferative retinopathies of any cause, epiretinal membrane, retinal dystrophy, choroidal neovascularization, ocular trauma, ocular tumor.

7. Patients with a history of taking systemic medications such as oral steroids.

8. Patients with history of any previous ocular surgery or intravitreal medication.

Method

All subjects underwent ophthalmologic examination including best-corrected visual acuity, axial length, autorefraction, slit-lamp examination of anterior chamber and lens, and fundus examination with super field non- contact lens and OCT at macular area with a Cirrus HD-OCT (Carl Zeiss Meditec, Dublin, CA, USA) with EDI (enhanced depth-imaging) mode. All data were recorded in a Data record sheet. HD-OCT was performed by a trained technician in macular line protocol.

Subfoveal choroidal thickness was measured from the perpendicular line between the outer border of the hyperreflective line corresponding to the retinal pigment epithelium and the inner surface of the hyperreflective line corresponding to the chorioscleral interface at the fovea region (Figure 2). The manual line was traced by a single ophthalmologist. The quality of the OCT images was assessed. To be included in this study, the quality of the images had to be at least 6 out of 10 in signal intensity. Subfoveal choroidal thickness was measured 5 times in

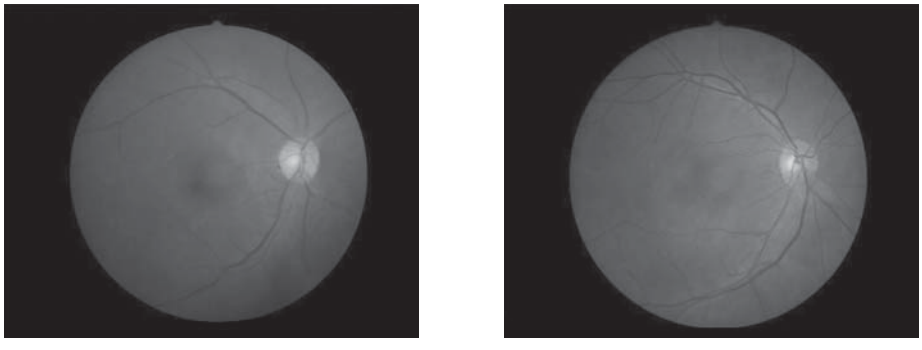

Figure 1: Fundus photos in normal eye (A) compare with CSC eye (B).

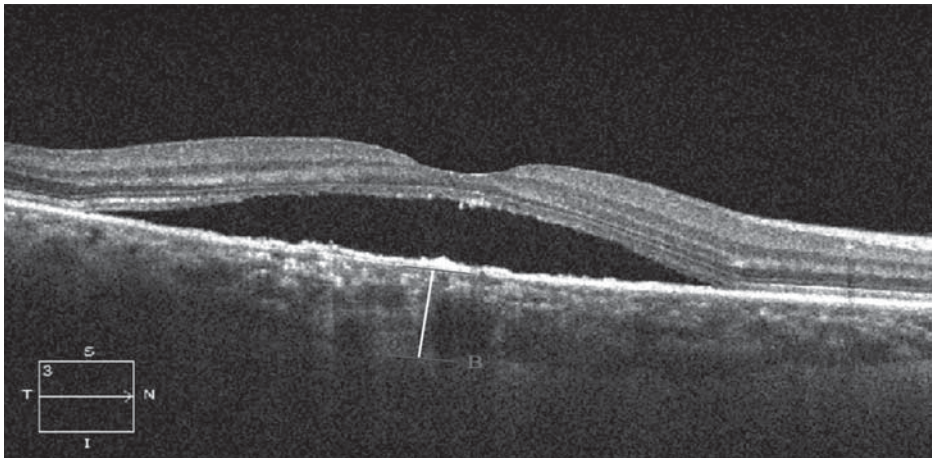

Figure 2: Subfoveal choroidal thickness was measured from the perpendicular line between the outer border of the hyperreflective line corresponding to the retinal pigment epithelium (A) and the inner surface of the hyperreflective line corresponding to the chorioscleral interface at the fovea region (B). (white line from Cirrus HD Optical Coherence Tomography in CSC eye).

each eye and the average of these 5 values was calculated for subfoveal choroidal thickness of each eye. In determining which eye to record as data for the normal eyes group, only the eye with the highest subfoveal choroidal thickness was used.

Statistical analysis

Descriptive statistics included mean and standard deviation for continuous variables. Independent T-test was used for comparison between the means of two independent groups. Pearson Chi-square test was used to evaluate the difference between categorical data. Statistical analyses were performed by using commercial software (SPSS version 23). Values of $P<0.05$ were considered to be statistically significant.

Results

Thirty patients (30 eyes) were included in the study with 15 normal eyes of healthy patients, and 15 eyes with central serous chorioretinopathy. The mean age of 15 patients with CSC eyes was 46.13 ± 10.70 years old. Thirteen were male (86.67%) and two were female (13.33%). The mean age of 15 patients with normal eyes was 60.07 ± 11.91 years old. Seven were male (46.67%) and eight were female (53.33%). Mean autorefraction value in CSC eyes was 0.76 ± 0.56 diopter and normal eyes was 1.43 ± 0.92 diopter. Mean axial length of CSC eyes were 23.22 ± 0.56 and 23.24 ± 0.72

Table 1: Descriptive statistics in demographic data of patients in this study.

Factors	CSC eyes (n = 15)	Normal eyes (n = 15)	P value
Sex			
Male	13(86.67%)	7(46.67%)	0.02++,*
Female	2(13.33%)	8(53.33%)	
Age (years old)			
31-40	4(26.67%)	1(6.67%)	
41-50	6(40%)	2(13.33%)	
51-60	3(20%)	5(33.33%)	
61-70	2(13.33%)	3(20%)	
71-80	0	4(26.67%)	
Mean age (mean±SD)	46.13±10.70	60.07±11.91	0.002+,*
BCVA logMAR score			
< 0.2	5(33.33%)	9(60%)	
0.2-0.3	3(20%)	6(40%)	
0.3-0.4	1(6.67%)	0	
0.4-0.6	3(20%)	0	
0.6-0.7	3(20%)	0	
Mean (mean±SD)	0.32±0.23	0.2±0.07	0.063+
Axial length (millimeters) (mean±SD)			
	23.22±0.56	23.24± 0.72	0.876+
Autorefraction (diopter) (mean±SD)			
	0.76±0.56	1.43±0.92	0.102+

+ Independent T-test , ++ Pearson Chi-square test, *P < 0.05

millimeters in normal eyes respectively. In CSC eyes, the mean BCVA logMAR score was 0.32 ± 0.23 and in normal eyes, the mean BCVA logMAR score was 0.2 ± 0.07. There was no statistically significant difference of demographic data between the two groups in every parameter except sex and mean age. (Table 1)

Subfoveal choroidal thickness

The mean subfoveal choroidal thickness of CSC eyes was 390.96 ± 55.12 μm and normal eyes was 250.69 ± 69.95 μm. The subfoveal choroidal thickness in CSC eyes was thicker than normal eyes with statistically significance (P < 0.05). (Table 2)

Table 2: The comparison of mean subfoveal choroidal thickness between CSC eyes and normal eyes.

	CSC eyes (n = 15)	Normal eyes (n = 15)	P value
Choroidal thickness (μm) (mean ± SD)	390.69 ± 55.12	250.69 ± 69.95	< 0.001*

Independent T-test, *P < 0.05

In a subgroup analysis of subfoveal choroidal thickness in different age groups, we found that the mean subfoveal choroidal thickness in CSC eyes was thicker than normal eyes in every age group. (Figure 3) The age groups of 41-50, 61-70 and 71-80, subfoveal choroidal thickness in CSC eyes were significantly thicker than normal eyes. (Table 3)

Table 3: Subgroup analysis of mean subfoveal choroidal thickness in different age groups in CSC eyes and normal eyes.

Age group (years old)	CSC eyes (n = 15)		Normal eyes (n = 15)		Mean difference	95% CI	P value
	amount (n)	Choroidal thickness (μm) (mean ± SD)	amount (n)	Choroidal thickness (μm) (mean ± SD)			
31-40	4	380.65 ± 57.95	1	265.60	121.66	-75.39 to 313.72	0.144
41-50	6	409.63 ± 60.34	2	284.20 ± 63.64	125.43	3.74 to 247.11	0.045*
51-60	3	374.20 ± 70.18	5	299.62 ± 70.15	74.58	-50.80 to 199.96	0.196
61-70	2	378.70 ± 27.29	3	220.93 ± 54.53	157.77	20.55 to 294.98	0.035*
71-80	0	0	4	191.35 ± 50.49	-191.35	-370.99 to -11.71	0.043*

Independent T-test, *P < 0.05

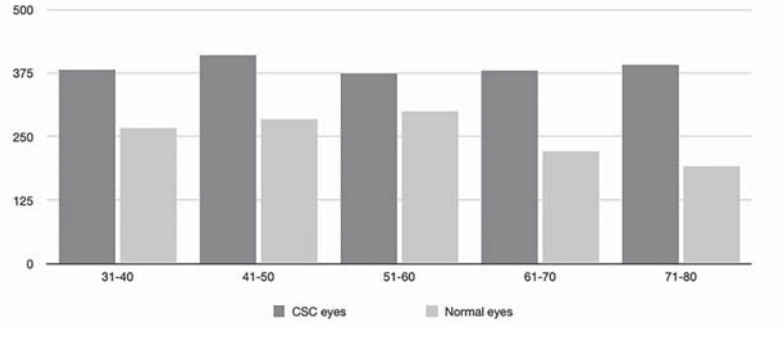

Figure 3: Bar graph shows mean subfoveal choroidal thickness in different age groups in CSC eyes in comparison with normal eyes.

Discussion

The pathophysiology of CSC remains poorly understood. The current understanding theories of the pathogenesis of CSC emphasizes the role of the choroid. The choroid is thought to be hyperpermeable in CSC, possibly as a result from stasis, ischemia, and inflammation processes of the choroidal layer. Several researchers have reported that mean subfoveal choroidal thickness in CSC eyes was thicker than normal eyes.[9-15] This study showed a mean subfoveal choroidal thickness 390.96 ± 55. 12 μm with a mean age of 46.13 ± 10.70 years old in CSC eyes, which is less than an Indian population and a Japanese population.[9, 14] However, the choroidal thickness was thicker than the study reported from Korea.[10] In normal eyes, this study showed a mean of subfoveal choroidal thickness 250.69 ± 69.95 μm with a mean age of 60.07 ± 11.91 years. This result was similar to the result of Southern Thailand and Indian population.[9, 16, 19] The differences in mean subfoveal choroidal thickness may result from the differences in the mean age, axial length, ethnicity and different OCT instrument of each study. This study also revealed that the majority of the patients with CSC eyes was male (86.67%), corresponding to higher prevalence of CSC in male.[4]

In the present study, we found that the mean subfoveal choroidal thickness in CSC eyes was thicker than normal eyes in every age group. The age groups of 41-50, 61-70 and 71-80, subfoveal choroidal thickness in CSC eyes were thicker than normal eyes with statistical significance, nevertheless, the interpretation of the results should be done carefully. Since the sample sizes in each age group were small, this may result in statistical interpretation.

There were some limitations in this study. Firstly, the subfoveal choroidal thickness was performed manually by one doctor. Although EDI-OCT increases sensitivity of choroidal image, the visualization of the chorioscleral interface in the foveal region was not clearly visible in some cases. Secondly, small sample sizes in this study may not reflect the normal population. Lastly, there has been no comparable normative data in CSC eyes available in the Thai population.

For future studies, we suggest swept source optical coherence tomography (SS-OCT) if available. Due to deeper penetration and faster acquisition time, SS-OCT has the ability to visualize choroid, vitreous, and retinal structures.

Conclusion

The mean subfoveal choroidal thickness was 390.96 ± 55.12 μm and 250.69 ± 69.95 μm in CSC eyes and normal eyes respectively. The mean subfoveal choroidal thickness in CSC eyes was thicker than normal eyes significantly.

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Potential conflicts of interest. All authors report no conflicts of interest relevant to this article.

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Ethics

This study was approved for ethical research in humans with the human research ethics committee of Thammasat university, Thailand (Research ID: MTU-EC-OP-1-243/61).

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