Choroidal Thickness Changes After Photodynamic Therapy and Recurrence of Chronic Central Serous Chorioretinopathy

YONG-KYU KIM, NA-KYUNG RYOO, SE JOON WOO, AND KYU HYUNG PARK

• PURPOSE: To investigate long-term changes in subfoveal choroidal thickness (SCT) after photodynamic therapy (PDT) and their relationship with chronic central serous chorioretinopathy (CSC) recurrence.

• DESIGN: Retrospective, observational, comparative case series.

• METHODS: Fifty-seven eyes with chronic CSC (52 patients, ≥2 years follow-up) treated with half-fluence or half-dose PDT were divided into 2 groups: those with incomplete CSC resolution or subretinal fluid (SRF) recurrence (SRF+) and those with complete SRF absorption without disease recurrence (SRF−). The SCT was measured using spectral-domain optical coherence tomography and relative SCT ratios (follow-up SCT: baseline SCT ratio) were compared between the 2 groups.

• RESULTS: Mean follow-up period was 33.9 ± 9.9 months (range: 24–62 months). Four of 57 eyes (7%) had persistent SRF after PDT and 12 of 53 eyes (22.6%) had initial SRF resolution with SRF recurrence. The SRF+ group had a slower reduction in SCT during the first month ($P < .001$) and a higher relative SCT ratio than the SRF− group throughout follow-up ($P < .001$). The relative SCT ratio at 1 month was highly predictive of CSC recurrence (area under the curve = 0.902, 95% confidence interval: 0.823–0.982). Using a relative SCT ratio cutoff of 93.1%, sensitivity of this measure was 93.8% and specificity was 78.1%.

• CONCLUSIONS: Those with incomplete SRF absorption or SRF recurrence had a slower SCT decline at 1 month and a higher SCT ratio throughout follow-up compared to those without CSC recurrence. The SCT changes may reflect PDT efficacy and help predict long-term recurrence and early treatment outcomes. (Am J Ophthalmol 2015;160(1):72–84. © 2015 by Elsevier Inc. All rights reserved.)

Accepted for publication Apr 8, 2015.

From the Department of Ophthalmology, Seoul National University College of Medicine, Seoul National University Bundang Hospital, Seongnam, South Korea (Y.K.K., N.K.R., S.J.W., K.H.P.); and Department of Ophthalmology, Hallym University College of Medicine, Kangdong Sacred Heart Hospital, Seoul, South Korea (Y.K.K.).

Inquiries to Se Joon Woo, Department of Ophthalmology, Seoul National University Bundang Hospital, #300 Gumi-dong, Bundang-gu, Seongnam-si, Gyeonggi-do 463-707, South Korea; e-mail: sejoon1@snu.ac.kr

CENTRAL SEROUS CHORIORETINOPATHY (CSC) IS A relatively common disorder and is characterized by serous detachment of the neurosensory retina with diffuse retinal pigment epithelium decompensation.[1] Although the exact pathophysiology of CSC remains unknown, indocyanine green angiography (ICGA) images have revealed hyperpermeable choroidal vessels[2] and enhanced-depth imaging optical coherence tomography (OCT) images have revealed a thickened choroid.[3] Both of these findings suggest that the disease originates in the choroid. Moreover, recent topographic studies have shown a high level of correspondence between angiographic (primarily choroidal hyperfluorescence) and OCT (primarily a thickened choroid) abnormalities.[4,5]

Although there is no standard therapy for CSC, photodynamic therapy (PDT) is gaining popularity as an effective treatment.[6,7] This therapy induces vascular endothelial damage and thrombus formation, causing short-term choriocapillary occlusion and long-term choroidal vascular remodeling. These changes result in caliber normalization of dilated, congested choroidal vessels[8–10] and are thought to be the mechanism by which PDT treats CSC. Various modifications to standard PDT were recently shown to be successful. These changes aimed to reduce potentially harmful effects of PDT and included reducing laser fluence[11–13] and photosensitizer dose.[14–16]

It is well known that choroidal thickness decreases after PDT in eyes with CSC. Maruko and associates[17] compared choroidal thickness changes in eyes with CSC treated with either laser photocoagulation or half-dose PDT. They found that although subretinal fluid (SRF) resolved in both groups, choroidal thickness decreased in only the PDT group. Several subsequent studies have also shown a decrease in choroidal thickness after half-fluence PDT in eyes with CSC.[5,18] However, even after PDT, angiographically abnormal areas present before treatment showed considerable choroidal thickening compared to other macular areas. This finding suggests that choroidal structural abnormalities, represented as choroidal thickening, is a possible cause of CSC recurrence.[5] Another study compared treatment efficacy of half-dose PDT and one-third-dose PDT for chronic CSC. In contrast to eyes treated with half-dose PDT, choroidal thickness did not change in 4 of 6 eyes receiving one-third-dose PDT

0002-9394/$36.00
http://dx.doi.org/10.1016/j.ajo.2015.04.011

TABLE 1. Demographic and Clinical Characteristics of Patients With and Without Chronic Central Serous Chorioretinopathy Recurrence Following Photodynamic Therapy

	SRF+ Group (N = 16)	SRF− Group (N = 41)	*P* Value[a]
Age, y	49.8 ± 10.7	48.0 ± 7.0	.873
Male, n (%)	13 (81)	33 (80)	>.999
Diabetes mellitus, n (%)	1 (6)	2 (5)	>.999
Hypertension, n (%)	2 (13)	7 (17)	>.999
Refractive error (SE, diopters)	−1.0 ± 2.5	−0.5 ± 1.1	.993
Follow up period (mo)	39.8 ± 12.9	31.4 ± 7.6	.062
Time span since first episode (mo)	11.9 ± 10.8	26.8 ± 41.2	.310
Previous or concurrent use of corticosteroid, n (%)	0	0	>.999
Previous CSC treatment, n (%)			.011
None or oral medication[b] only	9 (56)	37 (90)	
Focal laser	2 (13)	1 (2)	
Anti-VEGF treatment	5 (31)	3 (7)	
PDT parameters			
Distance from fovea to PDT spot center (μm)	951 ± 929	675 ± 630	.220
PDT spot size (μm)	2869 ± 934	2949 ± 790	.451
PDT spot location, n (%)			.173
Foveal	9 (56)	32 (78)	
Juxtafoveal	4 (25)	6 (15)	
Extrafoveal	3 (19)	3 (7)	
Half-fluence:half-dose, n (%)	13:3 (81:19)	26:15 (63:37)	.193
Visual outcome			
Baseline BCVA (logMAR)	0.63 ± 0.56	0.36 ± 0.32	.076
2-year BCVA (logMAR)	0.33 ± 0.46	0.14 ± 0.19	.255
2-year visual gain (logMAR)	0.31 ± 0.43	0.22 ± 0.24	.830
2-year BCVA improved, n (%)[c]	7 (44)	12 (29)	.297
2-year BCVA stable, n (%)[d]	16 (100)	40 (98)	>.999
Baseline OCT			
Central macular thickness (μm)	349.6 ± 81.9	409.0 ± 125.8	.124
Subfoveal choroidal thickness (μm)	405.8 ± 86.3	417.8 ± 133.8	.979
PED, n (%)	5 (31)	15 (37)	.767
Post-PDT 1-month OCT			
Central macular thickness (μm)	245.9 ± 54.7	229.2 ± 34.7	.472
% Central macular thickness	73.0 ± 19.0	60.4 ± 17.3	.019
Subfoveal choroidal thickness (μm)	397.5 ± 83.0	357.8 ± 119.1	.131
% Subfoveal choroidal thickness	98.1 ± 4.5	85.6 ± 10.1	<.001
Post-PDT 2-year OCT			
Central macular thickness (μm)	250.5 ± 80.7	238.9 ± 32.5	.440
% Central macular thickness	73.1 ± 17.6	62.6 ± 16.6	.039
Subfoveal choroidal thickness (μm)	374.0 ± 85.7	338.4 ± 107.9	.214
% Subfoveal choroidal thickness	92.2 ± 7.7	81.5 ± 11.9	.001
PED, n (%)	3 (19)	1 (2)	.129

BCVA = best-corrected visual acuity; CSC = central serous chorioretinopathy; logMAR = logarithm of the minimal angle of resolution; OCT = optical coherence tomography; PDT = photodynamic therapy; PED = pigment epithelial detachment; SE = spherical equivalent; VEGF = vascular endothelial growth factor.

SRF+ group = incomplete absorption or recurrence of subretinal fluid, SRF− group = complete subretinal fluid absorption without recurrence.

Data presented as mean ± standard deviation, where applicable.

[a]Mann-Whitney test used for continuous variables, χ^2 or Fisher exact test used for categorical variables.

[b]Acetazolamide or diuretics.

[c]Increase in visual acuity ≥3 lines.

[d]Decrease in visual acuity <3 lines.