ICG Angiographic Features of Myopic Subfoveal Choroidal Neovascularization as a Prognostic Factor Influencing Visual Outcome After Photodynamic Therapy

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Directed by Professor Koh Hyoung Jun

The Master's Thesis submitted to the Department of Medicine, the Graduate School of Yonsei University in partial fulfillment of the requirements for the degree of Master of Medical Science.

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To determine the influence of clinical features and Indocyanine green (ICG) angiographic features on the visual outcome of patients with myopic subfoveal choroidal neovascularization (CNV) who received photodynamic therapy (PDT). Thirty-six consecutive patients (39 eyes) with myopic CNV who were followed up for more than one year after PDT were enrolled in this study. Clinical features included age, gender, refractive error, great linear dimension and subretinal hemorrhage. ICG features included the lesion size, lacquer cracks, hypofluorescence surrounding the CNV (dark rim), peripapillary atrophy size, and visible prominent choroidal veins under the macula. Linear regression analysis was performed using the change in visual acuity (ΔlogMAR) as the dependent variable, and the above-mentioned factors as independent variables.

At each month 12 and 24, younger age ($p = 0.002$, $p = 0.012$) and presence of dark rim ($p = 0.002$, $p = 0.031$) significantly correlated with increment in visual acuity (decrement in logMAR) after PDT. Other factors had no significant influence on change in visual acuity at month 12 and 24.

Younger patients and patients with a dark rim on ICG angiography had a higher chance of visual improvement after PDT in myopic CNV.

Key words: myopia, choroidal neovascular membrane (CNV), indocyanine green angiography (ICG), age, dark rim, visual outcome, photodynamic therapy (PDT)

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I. INTRODUCTION

Pathologic myopia is a major cause of legal blindness in developed countries.[1-2] The major complication leading to decreased central vision in pathologic myopia is choroidal neovascularization (CNV), which affects 5% to 10% of patients with high myopia.[3-5] Despite its importance as a cause of visual impairment in myopic patients, no effective treatments have been established except photodynamic therapy (PDT). The Verteporfin in Photodynamic Therapy (VIP) study group showed greater incidence of stable or improved vision in subfoveal myopic CNVs managed with PDT with verteporfin than placebo treated eyes.[6-7]

Recently, Montero and Ruiz-Moreno[8] showed that a patient's age at the onset of myopic CNV influences prognosis. The younger patient group (≤ 55 years old) had a better final visual acuity at one-year follow-up after PDT than did the older group of patients (>55 years old). Their study included 31 eyes (30 patients), and the mean age in the whole group was 54.9 (Standard deviation; SD 14.0) years. Ergun and associates[9] found in their 36 patient series that younger patients and patients with higher baseline visual acuity had a better treatment outcome at two-year follow-up after PDT. The mean age of the patients was 59.7 (SD 15.1) years. Axer-Siegel and associates[10] also demonstrated that the younger myopic CNV patient group (< 60 years old) had better final visual acuity and less visual loss after PDT. In their study of 29 patients, the mean age was 63.1 (SD 14.11) with a mean follow-up period of 11.5 (SD 9.9) months. Based on their observations, they insisted that patient age was the most important prognostic factor of treatment outcome after PDT. However, these studies have some limitations. They included too many elderly patients, which might cause neovascular degeneration of degenerative myopia to be confused with age-related macular degeneration. They also had no comparative groups, so it is not clear whether the better visual outcomes of the young patients were due to an effect of PDT or due to the natural course of myopic CNV in young patients.

In degenerative myopia, blood flow in the choroidal vessels is delayed, and the choriocapillaries show severe circulatory disturbances.[11-13] Since new vessels originated from the choroids, the hemodynamic characteristics must depend on those of the choroids. For example, the incidence of neovascularization may increase with the progression of degenerative changes in myopic eyes. However, the development of CNV requires the relative preservation of the choriocapillaries.[14] It is also known that the macular depends almost entirely on choroidal circulation. The visual prognosis of myopic CNV after PDT may not only be influenced by the characteristics of the CNV, but also by the state of the choroid and the choriocapillaries. Indocyanine green (ICG) angiography can better document choroidal vessels because of its better penetration of near-infrared light into the choroids.[15-22] However, there have been no reports examining the ICG findings as a prognostic factor for the visual outcome of myopic CNV after PDT.[6-10,23]

The ‘dark rim’ was named by Scheider and associates.[15] They observed the network of choroidal neovascularization within the choroidal hypofluorescent area in ICG angiograms. There were a few reports about a dark rim found in idiopathic CNV and myopic CNV.[16-18] However, there had been no reports describing the relationship between the presence of a dark rim and the visual prognosis of idiopathic or myopic CNV.

The purpose of this study was to evaluate the visual improvement of myopic CNV when treated with PDT, and to establish a relationship between age and visual outcome. We also examined other clinical and ICG angiographic characteristics as prognostic factors for the visual outcome after PDT.

II. MATERIALS AND METHODS

Thirty-eight consecutive patients (41 eyes) with pathologic myopia and subfoveal CNV treated with verteporfin (Visudyne, NovartisAG, Basel, Switzerland) PDT at Yonsei University Medical Center between May 2002 and August 2004 were identified. Two patients were excluded because they were lost to follow-up, and the remaining 36 had completed at least 12 months of follow-up. The study comprised 39 eyes of these 36 patients. Informed consent was obtained from all patients. Approval from the institution's ethics committee was not required for this retrospective study.

Pathologic myopia was defined as an eye requiring a distance correction of at least −6.0 diopters (D; spherical equivalent).[4,6] Patients with angioid streaks, evidence of histoplasmosis, choroiditis, idiopathic CNV or other causes of CNV were excluded. Subfovea was defined as an involvement of the center of the foveolar avascular zone.

PDT was administrated according to the TAP study protocol,[24,25] with follow-ups at one week, one month, three months, and then every three months thereafter. If there were signs of fluorescein leakage three months after PDT, the PDT was repeated. Fluorescein angiography and ICG angiography were repeated on the initial examination and every subsequent follow-up visit.

All patients received comprehensive ocular examinations including dilated fundus photography, fluorescein angiography and ICG angiography at the baseline investigation and again every three months thereafter. Best-corrected visual acuity was measured with a modified ETDRS chart.

The patient characteristics retrieved from the medical charts included age, gender, refractive errors, ETDRS visual acuity, and number of treatments. The greatest linear dimension (GLD) (including the CNV, area of leakage, and area of blocked fluorescence in the lesion, according to the TAP study) was measured manually on the fluorescein angiograms.[6]

The indocyanine green (ICG) angiography was performed with a scanning laser ophthalmoscope (HRA). The ICG angiograms were reviewed by two examiners (SH Byeon, HJ Koh) for the lesion size on ICG angiography (ratio of the total area of the lesion divided by the area of the optic disc (DA)) and associated findings, including hypofluorescence surrounding the CNV (dark rim), lacquer cracks, prominent large choroidal veins in the macula, and peripapillary choroidal atrophy size.[15-22] The presence of an ICG angiographic dark rim (hypofluorescence around the CNV) was defined as a round-shaped background hyperfluorescence within which a hyperfluorescent island appeared during the early phase (Figures 1, 2).[15-19] The presence of lacquer cracks was identified using late-phase ICG angiography (Figures 1, 3).[17,20] Regarding the presence of visible large choroidal veins under the macula, the focal dilation of the choroidal veins in the posterior fundus during the early phase of ICG angiography was defined; some showed hyperfluorescence until the late-phase of the angiogram (Figure 2).[16,21] The area of peripapillary atrophy (islands of non-perfusion or reduced perfusion in the deep choroid in early or late hypofluorescence) was defined as the ratio of the total area of peripapillary atrophy divided by disc area on ICG angiography.[20,22]

To evaluate the relative impact of the baseline predictors (the clinical and ICG angiographic features) on the visual outcome, a linear regression analysis was performed. The main outcome measure was the change in logMAR value during the follow-up period (△logMAR), obtained by the subtraction of the baseline logMAR value from the final logMAR value 12 months after PDT. A linear regression analysis was performed using the change in visual acuity (△logMAR) as the dependent variable, and the above-mentioned factors as independent variables. The potential prognostic effects were assessed by using both univariate and multiple linear regression analyses. All reported P-values were the results of two-sided tests. P-values ≤.05 were considered statistically significant. The SPSS 12.0 software for

Windows (Chicago, Illinois, USA) was used for the statistical calculations.

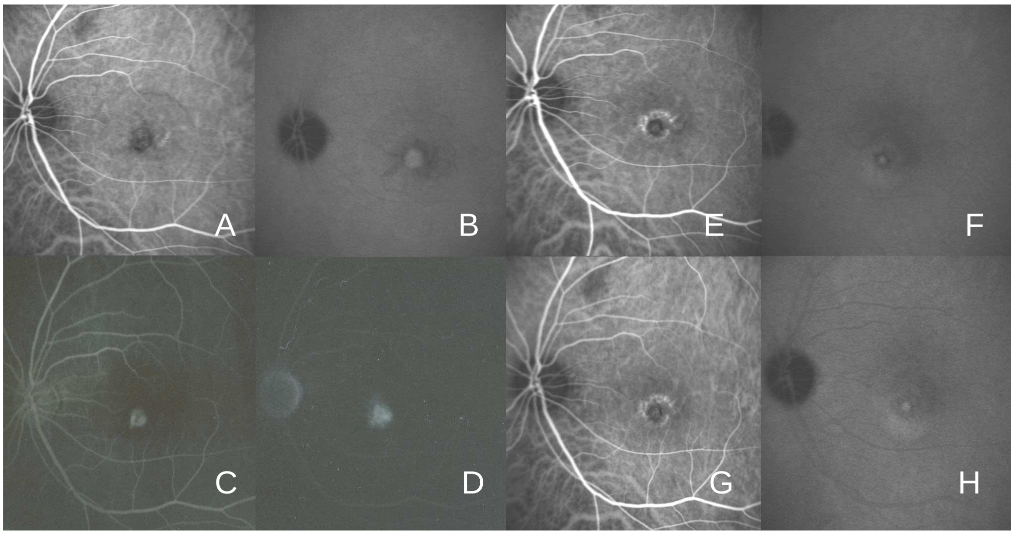

Figure 1. Angiography of a 30-year-old man with myopic sub-foveal CNV in his left eye. At the initial examination, the patient's best-corrected visual acuity was 20/200. The refractive error was -9.0 diopters. (A) An early phase ICG angiogram demonstrated the hypofluorescence surrounding the CNV (dark rim). (B) Late phase ICG angiography showed lacquer cracks radiating from the lesion. (C, D) Fluorescein angiography showed a classic type hyperfluorescent lesion. At 12 months follow-up, the patient's visual acuity was improved to 20/40. (E, F) ICG angiography showed the decreased size of the lesion and a more prominent dark rim. At 24 months follow-up, the patient's visual acuity remained 20/40. (G, H) ICG angiography showed the remaining smaller lesion.

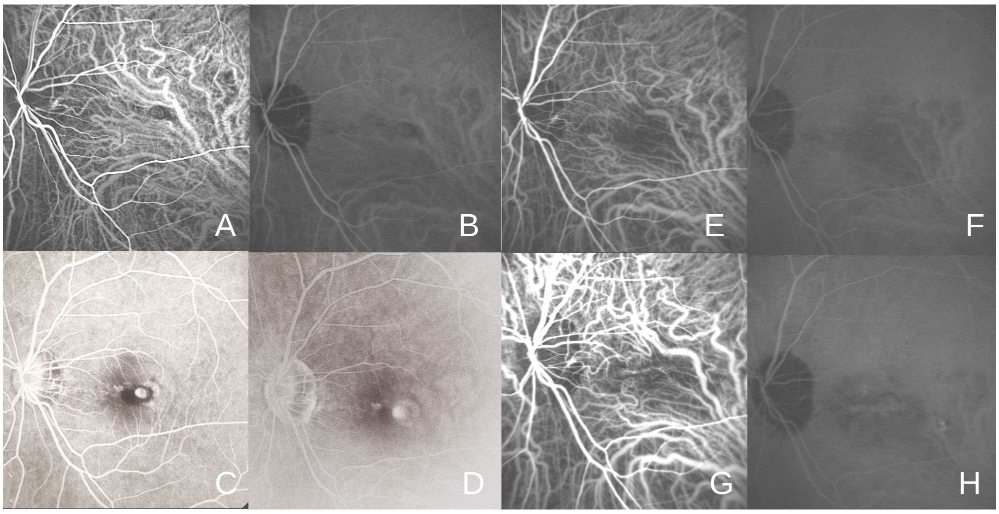

Figure 2. Angiography of a 55-year old man in his left eye. At the initial examination, the patient's best-corrected visual acuity was 20/200. The refractive error was -9.0 diopters. (A) An early phase ICG angiography showed a dark rim surrounding the CNV, and an adjacent small-blocked fluorescence due to hemorrhage and a bifurcate prominent choroidal vein. (B) Late phase ICG angiography revealed the visible hyperfluorescent choroidal vein on the macula, but no lacquer crack. (C, D) Fluorescein angiography showed a classic type CNV with an adjacent blocked fluorescence due to hemorrhage (E, F) At the 12-month follow-up, the patient's visual acuity was improved to 20/160. The lesion and the dark rim became less prominent. Persistent prominent choroidal veins were noted. (G, H) At the 24-month follow-up, the size of the CNV was enlarged even after receiving PDT five times. The patient's visual acuity was decreased to 20/200.

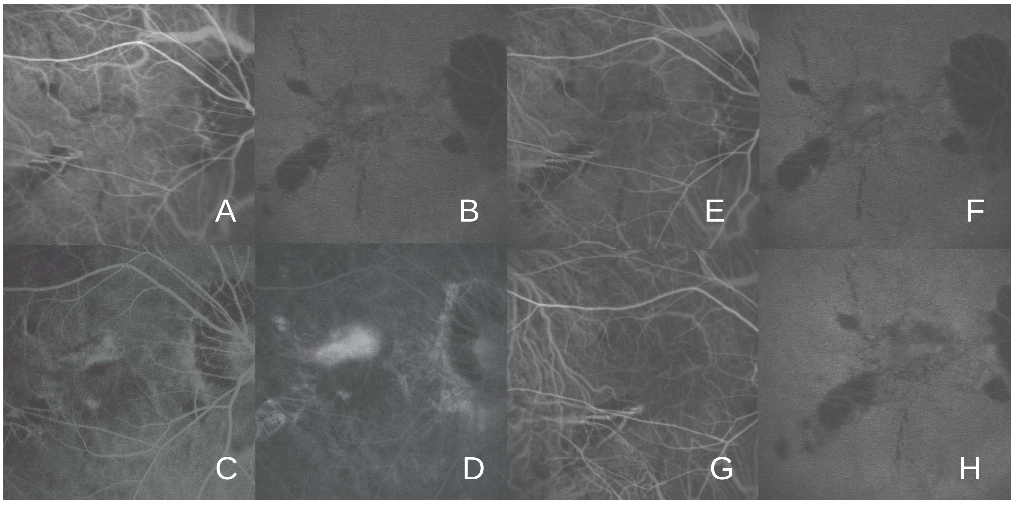

Figure 3. ICG angiography of a 58-year old woman in her right eye. At the initial examination, the patient's best-corrected visual acuity was 20/63. The refractive error was -11.0 diopters. (A) The mid phase ICG angiography showed the lesion to be slightly more hyperfluorescent than the background. (B) The late phase revealed dye leakage beyond the previous lesion with multiple lacquer cracks. (C, D) Fluorescein angiography showed a large classic CNV. (E, F) At a 12 month follow-up, the patient's visual acuity was decreased to 20/200. The ICG angiography showed a similar appearance of the baseline ICG angiography despite four times of PDT during 12 months. (G, H) At the 24 month follow-up, the patient's visual acuity had returned to 20/125. During the 24 month follow-up, she underwent PDT five times.

III. RESULTS

1. Baseline characteristics of patients

Thirty-nine eyes from 36 patients with subfoveal CNV secondary to pathologic myopia had completed 12 months of follow-up. Twenty four eyes from 22 patients had completed 24 month's follow up. Fifteen patients couldn't complete the 24 month follow up. Among them, four patients refused to follow up.

All were Korean. There were 24 (66.7%) females. The mean age of patients at presentation was 44.1 (SD; standard deviation =15.0) years, ranging from 25 to 74 years. Refractive error ranged from -6.00 D to -23 .00 D, and the mean was -10.78 (SD=3.80) D. The average number of treatments during the 12 months of follow-up was 2.4 (SD=1.2). The mean GLD of lesions on fluorescein angiography was 1775 (SD= 976) µm (range; 400 – 4280) at presentation. Submacular hemorrhages visible on fundus photography and fluorescein angiography were found in 8 of 39 eyes. The mean area of lesions visible on ICG angiography was 0.71 (SD= 0.61) DA (range; 0.08 – 2.24). The lacquer cracks were found in 27 of 39 eyes. The mean area of peripapillary choroidal atrophy on ICG angiography was 2.0 (SD= 2.4) DA. The hypofluorescence surrounding the CNV (dark rim) was found in 15 of 39 eyes, and prominent large choroidal veins were noted under the macula in 13 of 39 eyes.

2. Visual outcome at 12 month (39eyes) and 24 month (24eyes) of follow up

The presenting best-corrected visual acuity measured with an ETDRS chart was greater than 20/40 in four (10.3%) eyes, 20/40 to 20/200 in 26 (66.7%) eyes, and less than 20/200 in nine (23.0 %) eyes. The baseline mean logMAR was 0.82 (SD= 0.43). At the 12-month follow-up, the best-corrected visual acuity was greater than 20/40 in six (15.4%) eyes, 20/40 to 20/200 in 25 (64.1%) eyes, and less than 20/200 in eight (20.5%) eyes. The mean logMAR was improved to 0.69 (SD= 0.50).

For those 24 eyes that completed 24 months' follow up, the presenting visual acuity was greater than 20/40 in 1 (4.2%) eyes, 20/40 to 20/200 in 16 (66.7%) eyes, and less than 20/200 in 7 (29.2%) eyes. The baseline mean logMAR was 0.89(SD=0.45). At 24 months follow up, best-corrected visual acuity was greater than 20/40 in 4 (16.7%) eyes, 20/40 to 20/200 in 13(54.2%) eyes, and less than 20/200 in 7 (29.2%) eyes. The 24 months mean logMAR was 0.80

(SD= 0.57).

The change in visual acuity form baseline at the month 12 and month 24 examination is shown in table1.

3. Results of regression models

When clinical features including age, gender, refractive error, baseline visual acuity, baseline GLD and submacular hemorrhage and ICG features including the size of CNV, lacquer cracks, area of peripapillary atrophy, dark rim, and a prominent large choroidal vein were examined as prognostic factors by univariate analysis, age and the presence of a dark rim had a statistically significant effect on a change in logMAR(△logMAR) at each 12 months (Table 2) and 24 months (Table 3). On a multivariate analysis, age and the presence of a dark rim still remained statistically significant at each 12 and 24 months (Table 2, 3) (Figure 4, 5)

Table 1. Change in visual acuity fallowing PDT at the month 12 and month 24 examination

Change from Baseline in Visual Acuity	No. (%) of Patients		
	12 month (n=39)	12 month (n=24)*	24 month (n=24)*
Six-line or more increase	7 (18)	5 (21)	4 (17)
One-line or more to less than six-line increase	14 (36)	8 (33)	5 (21)
No change	9 (23)	5 (21)	8 (33)
One- line or more decrease	9 (23)	6 (25)	7 (29)
		P= 0.367	
Mean change in lines	+1.282	+1.292†	+0.917†

* Cases completed 24 month's follow up.

† Pared t-test; There were no difference of change in visual acuity between 12 month and 24 month

Table 2. 12 month results of the linear regression models for the single and the combined influence of covariates on the change in the logMAR value from baseline to 12 months (N=39).

Covariate	Univariate		Multivariate*	
	Beta (se)	P value	Beta (se)	P value
Age	0.012(0.003)	0.001	0.010(0.003)	0.002
Gender (female)	0.201(0.110)	0.075	-	-
Refractive error	−0.007 (0.015)	0.652	-	-
Baseline VA	−0.148(0.127)	0.253	*	*
Baseline GLD (μm)	0.000(0.000)	0.145	-	-
Subretinal hemorrhage	−0.027(0.136)	0.842	-	-
Lesion on ICGA (Disc Area)	0.136(0.091)	0.141	-	-
Lacquer cracks	0.092(0.118)	0.444	-	-
Peripapillary atrophy (Disc Area)	−0.005(0.024)	0.833	-	-
Dark rim	−0. 333(0.099)	0.002	−0.315(0.093)	0.002
Prominent choroidal vein	0.112(0.115)	0.340	-	-

VA = Visual acuity; GLD = greatest linear dimension. se = standard error

*Baseline logMAR values were adjusted for the control of the imbalance in multivariate analysis.

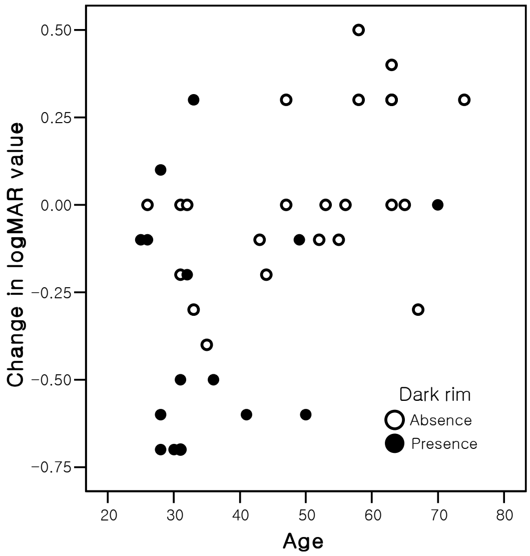

Figure 4. Scattergram of 12 month results of change in logMAR after photodynamic therapy according to age and dark rim.

Table 3. 24 month results of linear regression models for the single and the combined influence of covariates on the change in the logMAR value form baseline to 24 months. (N=24)

Covariate	Univariate		Multivariate*	
	Beta (se)	P value	Beta (se)	P value
Age	0.016(0.004)	0.001	0.012(0.004)	0.012
Gender	0.254(0.151)	0.106	-	-
Refractive error	-0.009(0.022)	0.689	-	-
Baseline VA	-0.058(0.179)	0.750	*	*
Baseline GLD (μm)	0.000(0.000)	0.740	-	-
Subretinal hemorrhage	-0.011(0.195)	0.957	-	-
Lesion on ICGA (Disc Area)	0.166(0.125)	0.197	-	-
Lacquer cracks	0.144(0.180)	0.431	-	-
Peripapillary atrophy (Disc Area)	-0.16(0.032)	0.671	-	-
Dark rim	-0.455(0.144)	0.005	-0.342(0.148)	0.031
Prominent choroidal vein	0.271(0.153)	0.090	-	-

VA = Visual acuity; GLD = greatest linear dimension. se = standard error

* Baseline logMAR values were adjusted for the control of the imbalance in multivariate analysis.

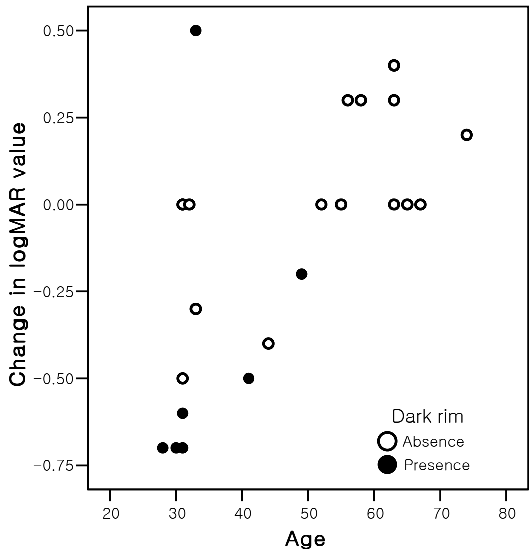

Figure 5. Scattergram of 24 month results of change in logMAR after photodynamic therapy according to age and dark rim.

IV. DISCUSSION

In our results, about 50% or more of the myopic CNV patients showed visual improvement at 12 months after PDT. At 24 months, about 40% or less of patients maintained their improved vision. We found that patients older than 50 years rarely had visual improvement after PDT over 12 months of follow-up. Both the age at onset and the ICG angiographic feature (dark rim) were related to the change of visual acuity from the baseline. Younger age and the presence of a dark rim were good prognostic factors after PDT. Our series contained a relatively large number of patients who had visual improvement after PDT. This may be due to the younger age distribution in our series compared to other studies.

In 12 month results of VIP trial, the verteporfin-treated group had significant reduction in visual loss compared to the placebo group.[6] But, in 2-year results, the primary outcome, the prevention of moderate visual loss (approximately <1.5 lines of visual acuity loss), was no longer significantly different.[7] It is not clear whether there have been true loss of efficacy in treated group or fluctuation of vision as results of random variability. But, the verteporfin-treated group had more chance of improving vision compared with a placebo group.[7] The myopic CNV is prevalent in working age people, not only the prevention of legal blindness but also the improvement of vision is important.

Some reports showed that patients who were younger at the onset of CNV might be able to retain good vision even without any treatment during follow-up.[26-29] Because our study did not have a comparative group, it was not clear whether the better visual outcomes of young patients in our series were due to an effect of PDT or due to the natural characteristics of myopic CNV in young patients. The reports on the natural history of CNV in high myopia vary, and most of them to date provide conflicting information.[6,7,26-31] This may be because their studies enrolled a variety of eligible patients, represented variable topographies of the lesion, contained different patient age distributions, and had a variable follow-up periods. Our study had similar eligibility criteria and age distributions to the Yoshida and associates' study, which found that younger myopic CNV patients retained good visual acuity without any treatment.[28] Japan and Korea have ethnic and geographic similarities as well as a prevalence of high myopia. They examined 63 consecutive patients (73 eyes) with myopic CNV. They then divided the patients into two groups according to their ages (≤ 40 and > 40 years old) and followed them for more than three years. For comparison, we also divided our patients into two groups at the age of 40 (Table 4).

Table 4. Comparison of the current photodynamic therapy series with another series managed by observation

	Observation Yoshida et al [28]		Photodynamic therapy Byeon et al	
	≤40 years (n=26)	>40 years (n=47)	≤40 years (n=10)	>40 years (n=14)
Age [mean (SD)]	29.8(5.7)	54.6(9.2)	30.4(3.1)	56.2 (9.3)
Refractive error (D) [mean (SD)]	-13.6(4.4)	-13.2(4.2)	-10.8 (4.9)	-10.8 (2.7)
Follow-up (month) [mean (SD)]	82(29.5)	86(48.0)	24(0)	24(0)
Baseline logMAR [mean (SD)]	0.44(0.39)	0.89(0.53)	0.82(0.45)	0.95(0.46)
Final logMAR [mean (SD)]	0.33(0.44)	1.12(0.42)	0.52(0.49)	1.01(0.55)
Paired t test	ns	P=0.02	P=0.046	P=0.462

SD = standard deviation, ns = not significant

In our study, the younger group (≤ 40) had significant improvement in visual acuity. In their series of natural history, even though the younger patients retained relatively good visual acuity, they did not have significant visual improvement. We could postulate that PDT might increase the chance of visual improvement in myopic CNV patients, especially in the young patient group. However, our study had a shorter follow-up period, and our patients had a smaller mean refractive error.

In our 12-month multivariable regression model, the age of patients at onset significantly influenced the visual outcome, and the dark rim was another covariate significantly affecting visual outcome. We also found that a dark rim was more prominent as the CNV regressed with PDT during follow-up (Figure 1). Histologically, a dark rim corresponds to the multilayered, proliferated retinal pigment epithelium at the outer margin of the neovascular membrane.[18,19] If large parts of the CNV remained unperfused for several weeks after PDT, adjacent RPE cells may benefit from the interval required for the restoration of the CNV, and may also migrate and proliferate around the vascular net.[32] We postulated that patients with a dark rim had more potent regenerative potential of RPE and received more benefit from PDT.We thought that the dark rim found on the baseline ICG angiography was another indicator of the potent regenerative potential of RPE.

In age-related macular degeneration, the visual prognosis after PDT is related with the fluorescein angiographic subtype of CNV.[24,25] The size of the CNV is also related to the prognosis. However, in myopic CNV, the relationship between the size of CNV and visual outcome has not been fully elucidated.[6-10,23] In our series, there was no significant relationship. New vessels originating from the choroids, and the hemodynamic characteristics must depend on those of the choroids. In eyes with severely decompressed choriocapillaries, the size and activities of neovascularization might be decreased. The visual prognosis may not only be influenced by the characters of the CNV but also by the state of the choroids and the choriocapillaries. This could obscure the relationship between them.

Lacquer cracks are imaged with enhanced delineation with ICG angiography.[17, 20] There were a few reports regarding the pathophysiologic relationship between lacquer cracks and CNV and visual outcomes.[20, 33] However, in our results, the presence of lacquer cracks had no significant effects on visual outcome after PDT.

There were some reports that an anatomic connection with the arteries or veins of choroids is a factor influencing the natural course of CNV.[16, 21, 34, 35] We postulated that the visible prominent choroidal veins in the macula may reflect the thinned choroidal vasculatures, which may in turn affect the visual prognosis of myopia. In our study, there were no significant relationships between the presence of a choroidal vein and the visual outcomes at 12 and 24 months (data not shown). In the univariate analysis of choroidal vessels at a 24-month follow-up the presence of a prominent choroidal vein in the macular correlated with a decrease in visual acuity, even though it was not significant (P = 0.090). This relationship was the third smallest P-valued influence on the change in the logMAR value after 24 months. This relationship might be more prominent if we examined them over a longer period of time.

The present study adopted the same angiographic endpoint as in the VIP study.[6, 7] The average number of treatments achieving complete absence of leakage in the first year and accumulated number in the second year was 2.4 and 3.0, which were much lower than 3.4 and 5.1 treatment sessions in the VIP study respectively. In Chinese population, Lam and associates[23] showed the number of treatments was also much lesser than in the VIP study. The pigmented RPE may provide a more protective effect from the unrestrained growth of the CNV after PDT, or there might be some other confusing factors accounting for the disparity in the average number of PDT treatment. But there was no comparative group, it was not clear whether Asian eyes (including Korean) with pigmented RPE provide a more protective effect from the unrestrained growth of the CNV after PDT.

Our study, however, has its own limitations, including a small sample size, a short follow-up period and no comparative control group. The prevention of later development of chorioretinal atrophy and further visual decrease over the long-term could not be assessed. Patients' ages at onset and ICG angiographic features (dark rim) were the significant prognostic indicators of the visual outcome after PDT in our series. In conclusion, younger patients and patients with a dark rim on ICG angiography had a higher chance of visual improvement after PDT in myopic CNV.

V. CONCLUSION

To determine what features did they have who experienced the more improvement of visual acuity after PDT. Younger patients of myopic CNV with dark rim found in ICG angiography at presentation had a more chance of visual improvement after PDT.

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Abstract (in Korean)

근시성 중심와하 맥락막 신생혈관에 대한 광역학 치료의 결과와 관련된 인도시아닌그린 혈관 조형술의 소견들

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근시성 맥락막 신생혈관 환자들에 있어서 광역학 치료 후 시력결과에 영향을 주는 임상적인 소견 및 인도시아닌 그린 형광안저촬영상의 소견에 대하여 연구하였다. 광역학 치료 후 1년이상 경과 관찰이 가능했던 근시성 맥락막 신생혈관 39안 36명을 대상으로 하였다. 임상적인 소견으로서 연령 및 성별과 근시의 돗수와 병변부위 중 최장 축과 동반된 망막하 출혈 유무를 조사하였으며, 인도시아닌 그린 형광안저촬영상의 소견으로써 병변의 크기, 래커칠 균열 유무, 맥락막 신생혈관을 둘러싸고 있는 저형광(검은 테두리)의 유무, 시신경 주변부 맥락막 위축 크기, 황반부에 두드러진 맥락막 혈관(주로 정맥)이 보이는지 여부를 조사하였다. 시력의 변화(▵logMAR)를 종속변수로 하고 위에 기술한

소견들을 독립변수로 하여 선형 회귀 분석을 시행하였다. 12개월과 24개월에 각각, 젊은 연령(p = 0.002, p= 0.012)과 인도시아닌 그린 형광안저촬영상의 검은 테두리가 있음(p = 0.002, p=0.031)이 시력의 호전과 의미있는 연관성이 있었다. 다른 소견들은 의미있는 연관성이 보이지 않았다. 결론적으로 젊은 환자와 인도시아닌 그린 형광안저촬영상 검은 테두리가 있는 환자는 광역학 치료가 시력 호전의 가능성을 높여줄 수 있다.

핵심 되는 말: 근시, 맥락막 신생혈관, 광역학 치료, 시력결과, 연령, 검은 테두리, 인도시아인 그린 형광안저촬영