Ophthal Focus

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A Study on Quantification of vascular morphology in Optical coherence tomography angiography in primary open-angle glaucoma

INTRODUCTION

GLAUCOMA

Glaucoma is a vision-threatening optic nerve condition marked by the gradual deterioration of retinal ganglion cells. Vascular health is believed to be a significant factor in glaucoma progression, as reduced blood supply to the eyes may lead to retinal ganglion cell loss, irrespective of intraocular pressure changes. While it's unclear whether vascular damage precedes ganglion cell damage or vice versa, understanding the eye's vascular structure can aid clinicians in diagnosing and assessing glaucoma [(1)]. Optical coherence tomography (OCT) imaging is vital for detecting and managing glaucoma. It allows for the quantitative evaluation of crucial neural structures such as the retinal nerve fiber layer (RNFL), optic nerve head (ONH), and macula [(2)]. Optical coherence tomography angiography (OCTA) is an extension of OCT [(1)]. OCTA provides additional insights into identifying glaucoma patients at risk of faster progression [(3)]. This study aimed to analyse microvascular metrics in healthy and primary open-angle glaucoma (POAG) eyes using OCTA. It also investigated the diagnostic potential of these metrics for distinguishing between healthy eyes and eyes with glaucoma.

Vascular morphology parameters such as vessel density(VD), vessel length density(VLD) and Branch point density(BPD) may provide additional significance in the diagnosis and estimation of glaucoma.

METHODS

The retrospective, cross-sectional study was conducted on 49 eyes from healthy subjects and 49 eyes from subjects with POAG. All participants received a thorough eye examination that encompassed various assessments such as visual acuity measurement, visual field examination, gonioscopy, dilated fundus photography, tonometry, and OCTA imaging. To be eligible for the study, individuals had to be older than 18 years, have a spherical equivalent of $\leq$ 3 diopters and

display open angles during gonioscopy. One eye was randomly chosen from each participant. The eyes were then divided into two groups: healthy and those with Primary Open-Angle Glaucoma. Furthermore, among the eyes with POAG, they were further categorized into mild, moderate, or severe stages. For the imaging process, all subjects underwent spectral-domain OCTA imaging to visualize vascular structures. Figure 1 provides OCTA scans for both healthy and POAG eyes at each layer. The three parameters to quantify vascular morphology: vessel density (VD), vessel length density (VLD), and branchpoint density (BPD) were assessed. These three parameters were compared between the healthy and POAG groups and employed logistic regression classification models to evaluate their diagnostic utility in distinguishing between healthy and glaucomatous eyes.

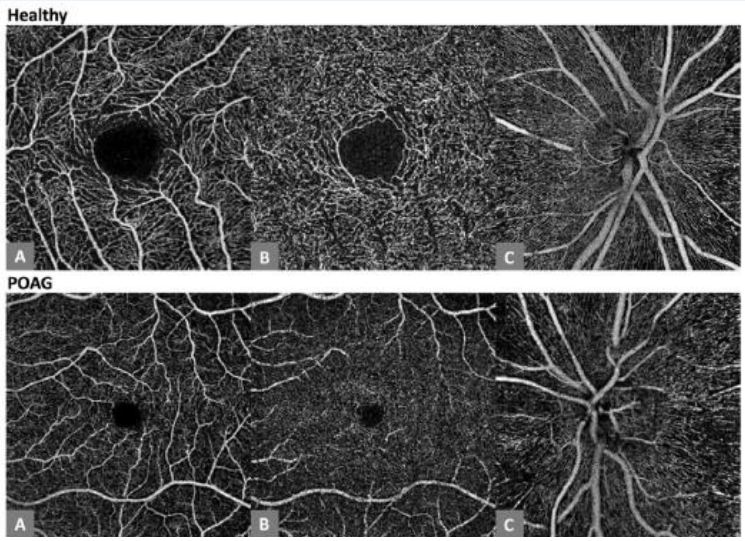

Figure 1 OCTA scans of healthy and POAG eyes in the superficial (A), deep (B), and radial peripapillary capillary (RPC) layers (C).

RESULTS

Among 49 eyes with POAG, there were different severity levels: 21 severe, 16 moderate, and 12 mild cases. People with POAG were older (average age 71.8 years) than healthy participants (average age 62.8 years). In POAG eyes, the average RNFL thickness was lower (74.8 μm) than in healthy eyes (101.1 μm). Table 1 presented the descriptive statistics for each OCTA parameter assessed in the RPC, deep, and superficial layers. Vessel density (VD), vessel length density (VLD), and branching pattern density (BPD) were significantly lower in all three scan layers for POAG eyes compared to healthy eyes. There was no overlap in the 95% confidence intervals between healthy and POAG eyes for any parameter. Both healthy and POAG groups had the highest mean VD, VLD, and BPD values in the deep layer, followed by the radial peripapillary capillary (RPC) layer and then the superficial

TABLE 1 Vascular morphology characteristics in healthy and glaucoma groups.

	Healthy (n =49)	Mild POAG	Moderate POAG	Severe POAG	All POAG
Superficial layer					
VD	0.259	0.240	0.199	0.176	0.202
VLD	0.112	0.104	0.085	0.073	0.086
BPD	0.049	0.046	0.040	0.037	0.041
Deep layer					
VD	0.343	0.310	0.279	0.237	0.271
VLD	0.170	0.153	0.135	0.112	0.131
BPD	0.073	0.066	0.059	0.052	0.058
RPC layer					
VD	0.313	0.262	0.234	0.202	0.229
VLD	0.119	0.101	0.086	0.070	0.084
BPD	0.052	0.042	0.039	0.034	0.038

layer. Parameters in the deep layer showed significant differences when comparing mild vs. moderate POAG, moderate vs. severe POAG, and mild vs. severe POAG. However, parameters in the superficial layer did not differ significantly when comparing healthy vs. mild POAG, mild vs. moderate POAG, or moderate vs. severe POAG. Standard deviation was consistently higher in the POAG groups for all parameters. RPC VD [AUC: 0.948] had the best performance overall among every parameter. In the superficial or deep layers, the RPC VD AUC was noticeably greater than any parameter's AUC. No significant differences were found between RPC VD AUC and other parameters in the RPC layer. Importantly, the VIF for each regression model indicated low collinearity among the variables.

DISCUSSION

In current study, Vessel density (VD), vessel length density (VLD), and branching pattern density (BPD) were significantly lower in all three scan layers for POAG eyes compared to healthy eyes. When distinguishing between healthy and diseased eyes, RPC VD performed the best. Liu K et.al., study showed that there was a marked reduction in vascular density (VD) across various macular regions. Utilizing OCTA for macular evaluation has the potential to offer a precise diagnostic method for identifying primary angle-closure glaucoma (PACG) in its early stages [(4)].

CONCLUSION

In glaucomatous eyes, vessel density(VD), vessel length density(VLD) and Branch point density(BPD)were lower, especially around the ONH. When distinguishing between healthy and diseased eyes, RPC VD performed the best. This implies that measuring vascular features beyond device-calculated VD could enhance glaucoma diagnosis and assessment.

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A study on association of Glycated haemoglobin and soluble CD163 in the development of diabetic retinopathy in adult patients with type 1 diabetes.

INTRODUCTION

Diabetic retinopathy(DR) is not just a significant diabetes complication; it's the leading cause of blindness in adults. In individuals with type 2 diabetes, approximately 50% will develop diabetic retinopathy. Several studies indicate a strong connection between the presence and progression of diabetic retinopathy and the HbA1c level [(1)]. Elevated levels of sCD163 have been observed in the vitreous of individuals with proliferative diabetic retinopathy (PDR) compared to those without diabetes. Furthermore, a study demonstrated that plasma sCD163 levels were higher in patients with any stage of diabetic retinopathy compared to those without DR. This suggests that in addition to HbA1c, plasma sCD163 might serve as a valuable biomarker for predicting the onset or progression of DR [(2)]. The study aimed to investigate the predictive capabilities of sCD163 and HbA1c for the advancement of DR by at least one stage in adults with type 1 diabetes who initially had no signs of DR or non-proliferative DR (NPDR).

In addition to HbA1c, plasma sCD163 may be a useful biomarker for the development of Diabetic Retinopathy.

METHODS

In this prospective study, 270 T1D (Type 1 Diabetes) patients (57% men, 43% women) were included. They met the criteria from a prior DR study (n=287) and had at least one follow-up fundus photography session. Fundus photos from baseline and up to 12 years later were graded according to the International Clinical Diabetic Retinopathy Disease Severity Scale. Blood samples were collected for sCD163 analysis. HbA1c levels were analyzed using an Olympus analyzer, along with serum lipids. Serum creatinine levels and the prevalence of macroalbuminuria were documented. Foot complications were categorized as present or absent. Cardiovascular disease (CVD) results were similarly categorized. Histograms showed non-normal distribution for

age, sCD163, HbA1c, serum lipids, and serum creatinine. Categorical data was analyzed using Linear-by-Linear Association, and logistic regression analyses were performed.

RESULTS

The DR prevalence increased from 72% at baseline to 82% at follow-up, with PDR patients being older, having longer diabetes duration, higher systolic BP, and more complications. PDR patients had higher sCD163 and HbA1c levels. At baseline versus follow-up, DR severity shifted: no apparent DR decreased from 28% to 18%, mild NPDR decreased from 20% to 13%, moderate NPDR increased from 24% to 26%, severe NPDR increased from 11% to 13%, and PDR increased from 17% to 30%. DR progressed in 45% of patients, most notably in those with mild and severe NPDR. Table 1 lists associations with "progression of DR at least one level". Two models linked DR development to high sCD163 and HbA1c levels, with HbA1c having a greater influence at higher quartiles than sCD163. Among all variables, only 'progression of DR at least one level' was linked to high sCD163 levels.

TABLE 1 High baseline HbA1c and sCD163 levels were independently linked to the development of diabetic retinopathy.

		Progression of diabetic retinopathy at least one level from baseline to follow-up					
				Model 1		Model 2	
		COR (95% CI)	P value	AOR (95% CI)	P value*	AOR (95% CI)	P value*
sCD163 quartiles	≥534 ng/mL (fourth)	2.8 (1.3 to 6.2)	0.010	-	-	2.4 (1.1 to 5.6)	0.036
	≥432 to <534 ng/mL (third)	2.7 (1.3 to 5.7)	0.011	-	-	2.4 (1.1 to 5.4)	0.031
	≥343 to <432 ng/mL (second)	2.9 (1.3 to 6.3)	0.007	-	-	2.9 (1.3 to 6.7)	0.011
	<343 ng/mL (first)	1		-	-	1	
sCD163 (ng/mL)	≥343 (>1st quartile)	2.8 (1.5 to 5.3)	0.002	2.6 (1.4 to 5.1)	0.004	-	-
HbA1c quartiles	≥71 mol/mol (fourth)	7.0 (3.0-16.2)	<0.001	-	-	7.4 (3.1 to 17.8)	< 0.001
	≥63 to <71 mol/mol (third)	3.8 (1.7-8.2)	0.001	-	-	3.6 (1.6 to 8.0)	0.002
	≥54 to <63 mol/mol (second)	2.4 (1.1-5.4)	0.025	-	-	2.5 (1.1 to 5.6)	0.024
	<54 mmol/mol (first)	1		-	-	1	
HbA1c (mmol/ mol)	≥54 (>1st quartile)	3.8 (2.0 to 7.4)	<0.001	3.8 (2.0 to 7.4)	< 0.001	-	-
Triglycerides (per mmol/L)		1.5 (1.0 to 2.1)	0.040	1.3 (0.9 to 1.9)	0.15	1.2 (0.8 to 1.7)	0.36
Follow-up period (per year)		1.05 (0.86 to 1.30)	0.66	-	-	-	-
***Logistic regression (backward: Wald): n=223; Nagelkerke R2 0.154/0.191.**							

DISCUSSION

The current study showed that PDR patients had higher sCD163 and HbA1c levels. DR development was linked to high sCD163 and HbA1c levels, with HbA1c having a greater influence at higher quartiles than sCD163. Dereke J et.al., study showed that in individuals with recent-onset type 1 diabetes, there was an elevation in sCD163 levels, and these levels increased in correlation with higher HbA1c levels [3].

CONCLUSION

In adult T1D patients, only increased sCD163 and HbA1c levels were independently linked to the progression of DR by at least one stage. Consequently, sCD163, along with HbA1c, could prove valuable as a risk biomarker for DR advancement.

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A study on Stereopsis in high myopic cataract patients with astigmatism following bilateral implantation of Toric intraocular lenses

INTRODUCTION

Toric Intra-ocular lens increased near and intermediate stereopsis acuity as well as Uncorrected intermediate visual acuity (UCIVA), uncorrected near visual acuity (UCNVA) and residual refractive astigmatism (RRA) in bilateral high myopic cataract patients with astigmatism.

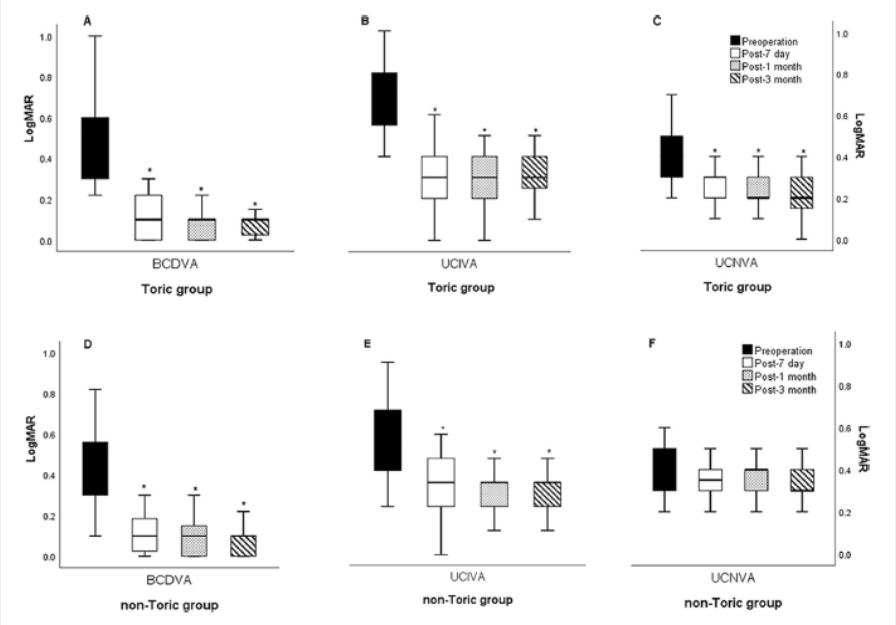
Corneal astigmatism is a prevalent condition, with over 40% of individuals requiring cataract surgery having at least 1 diopter (D) of astigmatism, and if left untreated it can lead to noticeable visual impairment [(1)]. Correcting ocular residual astigmatism with glasses is often not very effective. To address astigmatism in cataract patients with various corneal irregularities, Toric intraocular lenses (IOLs) are commonly used. Highly myopic cataract patients typically aim for a post-surgery refraction of around -3.0 D in both eyes to achieve clear binocular vision and comfortable near-distance tasks without glasses. Therefore, near stereopsis is vital for their vision after cataract surgery. However, there's a lack of quantitative studies on the near and intermediate visual acuity, as well as stereopsis, following Toric IOL implantation in bilateral highly myopic cataract patients [(2)]. This study assessed the visual acuity at different distances and stereopsis in bilateral highly myopic cataract patients after femtosecond laser-assisted cataract surgery (FLACS) with either Toric or non-Toric IOLs.

METHODS

In this prospective study, 40 patients with bilateral high myopia and senile cataract were chosen. They were divided into two groups based on Toric or non-Toric IOL implantation, totaling 80 eyes. One of the groups (the Toric group) had FLACS together with the implantation of a Toric IOL. The non-Toric group's FLACS procedure was paired with the Tecnis PCB00 IOL implantation. All patients underwent bilateral cataract surgery using the same procedure and IOL for both eyes. Inclusion criteria included pre-existing astigmatism >1.00 D, long axial length >26 mm, significant cataracts affecting daily life, habitual glasses wearers, and sufficient pupil dilation. Preoperative eye exams were conducted. The main outcomes were near and intermediate stereoacuity, best-corrected distant stereoacuity at 1 and 3 months' post-surgery. Secondary outcomes included visual acuity, spherical equivalent, and residual refractive astigmatism at 7 days, 1 month, and 3 months' post-surgery. Post-surgery, all patients received a specific eye drop treatment for the first week, gradually tapered over 3 weeks. Data analysis was done using SPSS software.

RESULTS

Figure 1 Comparison of BCDVA, UCIVA, and UCNVA in the toric and non-toric groups before and after surgery

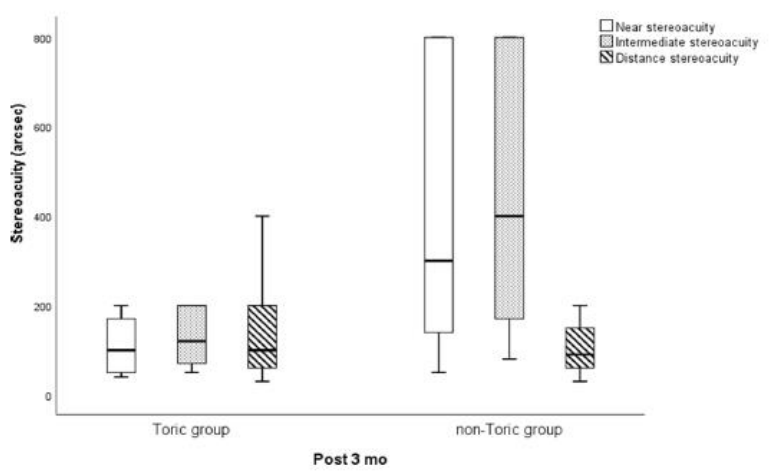


In the Toric group, there were 40 eyes from 20 patients (7 men, 13 women). The non-Toric group also consisted of 40 eyes from 20 patients (12 men, 8 women) with an average age of 59.1 years, ranging from 44 to 75 years. After surgery, the Toric group showed post-operative visual improvements, with Best-corrected distance visual acuity (BCDVA), at 0.08 logarithm of the minimum angle of resolution (logMAR) (FIG 1A) and uncorrected intermediate visual acuity (UCIVA) at 0.30 logMAR after 3 months (FIG 1B). Similarly, the non-Toric group also saw improvements, with BCDVA at 0.09 logMAR (FIG 1D) and UCIVA at 0.46 logMAR after 3 months (FIG 1E). Both groups exhibited significantly better vision than before the surgery. Concerning, uncorrected near visual acuity (UCNVA), the Toric group achieved a 3-month postoperative value of 0.23 logMAR (FIG 1C), which was notably better than their preoperative level. However, the non-Toric group did not show significant changes in UCNVA after surgery (FIG 1F). There were no significant differences in postoperative BCDVA between the two groups. Overall, the Toric group consistently outperformed the non-Toric group in terms of UCIVA and

UCNVA at all follow-up appointments. Additionally, the Toric group had lower residual refractive astigmatism (RRA) at the third postoperative month (0.44D) compared to the non-Toric group (1.49D). Furthermore, when it came to fine stereopsis at near (40 cm) and intermediate (80 cm) distances, the Toric group showed better results. Specifically, 65% of Toric group patients achieved 100 arcsec or better stereopsis at the near distance, compared to only 15% in the non-Toric group (FIG 2). Similarly, at the intermediate distance, 50% of Toric group patients achieved 100 arcsec or better stereopsis, while only 5% of non-Toric group patients achieved the same. In terms of Toric intraocular lens (IOL) stability, the mean absolute rotation at the third postoperative month was 4.08 degrees in the Toric group. Importantly, 80% of eyes in the Toric group had a Toric IOL rotation of no more than 5 degrees, indicating good stability.

DISCUSSION

Figure 2 Near, intermediate, and distance stereoacuity in the Toric and non-Toric groups at 3 months postoperatively.



The current study showed that bilateral high myopia cataract patients benefited from Toric IOLs, showing improved vision. Toric group showed post-operative visual improvements, with BCDVA at 0.08 logMAR and UCIVA at 0.30 logMAR after 3 months. the Toric group consistently outperformed the non-Toric group in terms of UCIVA and UCNVA. Keshav v et.al., study demonstrated that the employment of Toric intraocular lenses (IOLs) in individuals undergoing cataract surgery resulted in enhanced uncorrected visual acuity [(1)]. Warwick A et al., study showed that before toric intraocular lens insertion, the average best-corrected visual acuity (BCVA) was 0.50 logMAR, but it improved after surgery to an average uncorrected visual acuity (UCVA) of 0.35 logMAR. Notably, 65% of the eyes achieved a UCVA of 0.30 logMAR or better. Additionally, the mean refractive astigmatism decreased from 3.04 diopters (D) to 1.36 D after the procedure [(3)].

CONCLUSION

Axial length strongly affects Toric IOL rotation, posing challenges for high myopia cases. In comparison to non-Toric IOL implantation, FLACS with the implantation of a toric IOL improved UCMVA, UCNVA, and near and intermediate distance stereopsis acuity for bilateral high myopia

cataract patients with astigmatism. Toric IOL recipients had lower residual astigmatism and better spectacle independence compared to non-Toric IOL patients.

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A Case Report on Suspected Enhanced S-Cone Syndrome

INTRODUCTION

The retina of people with Enhanced S-cone syndrome exhibits a wide range of structural and functional abnormalities. For an appropriate diagnosis, a pathognomonic electroretinogram (ERG) is necessary.

Enhanced S-cone syndrome (ESCS) is a rare, slowly advancing retinal dystrophy with autosomal recessive inheritance. In this condition, the short-wavelength-sensitive cone photoreceptors are very responsive to light, while the rods, M-cones, and L-cones degenerate [(1)]. Common characteristics include circular pigmentary deposits located beyond the vascular arcades in the retinal pigment epithelium, often accompanied by macular schisis and small dot-like lesions. An electroretinogram (ERG) exhibits distinctive patterns, including the absence of rod responses, decreased M- and L-cone responses, and enhanced S-cone responses [(2)]. In this report, the case of a four-year-old girl who was under suspicion of suffering from ESCS was outlined. The patients mother had observed a decline in the girl's night vision. The results of the fundus examination and ERG provided robust evidence in favour of the ESCS diagnosis.

CASE PRESENTATION

A four-year-old child experienced vision problems for the previous four months. Her mother observed that the girl had terrible night time vision. Initially, both eyes wearing glasses had a visual acuity of 0.4. With spectacles, the right and left eyes cycloplegic refractions were +7.00 and +7.25, respectively. The majority of the clinical characteristics were bilateral and symmetric. The corneas and anterior chambers were normal with clear lenses, according to a slit-lamp examination. An examination of the fundus revealed bilateral numerous deep yellowish choroidal lesions that appeared punched out. These lesions included some pigmented ones. The macula was affected by massive, fibrosed lesions. According to coloured fundus pictures, the vitreous was clear (Figure1). Both the Immunoglobulin-G and Immunoglobulin-M tests for toxoplasmosis showed negative. There were positive results (+2) for antinuclear antibodies. On the electroretinogram (ERG), there was a decreased response for both the rod and cone and flicker. Multiple, rounded, subretinal, hyperreflective accumulations might be seen on an optical coherence tomography of the macula. As seen in (Figure 2), several of these accumulations were connected to cysts and intraretinal fluids. A decrease in peripheral retinal autofluorescence and an increase in macula autofluorescence are seen in fundus autofluorescence. Hyperautofluorescent lesions in a yellow-white coloration.

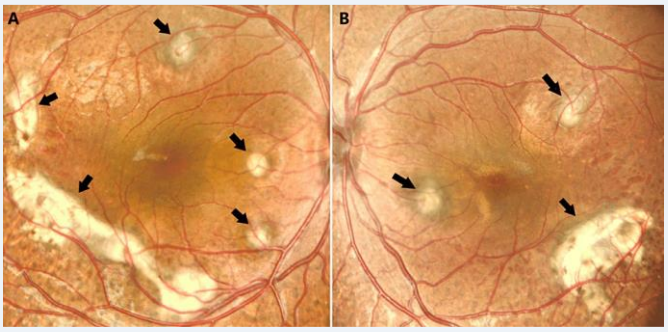

Figure 1 Coloured fundus images of the right (a) and left (b) eyes reveal bilateral numerous deep yellowish choroidal lesions (arrows). The head and vessels of the optic nerve are within normal bounds.

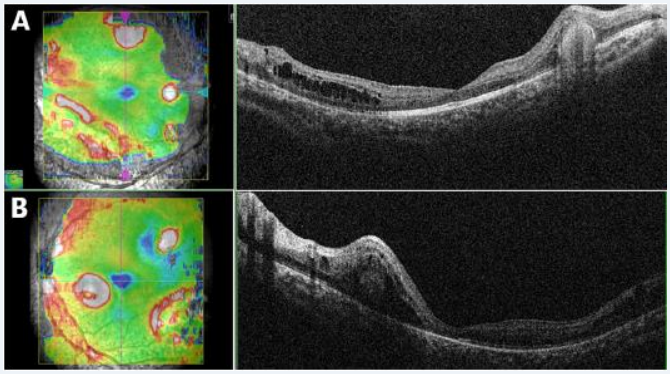

Figure 2 Multiple, rounded, subretinal, hyperreflective accumulations are visible on optical coherence tomography images of the right (a) and left (b) eyes, respectively. Some of these accumulations were linked to cysts and intraretinal fluids but lacked foveoschisis.

DISCUSSION

The current case showed, a 4-year-old child experienced night time vision loss. An examination of the fundus revealed bilateral numerous deep yellowish choroidal lesions. The macula was affected by massive, fibrosed lesions. Multiple, rounded, subretinal, hyperreflective accumulations was seen on an optical coherence tomography of the macula. de Carvalho ER et.al., study showed the average age of symptom onset for ESCS was 4.0 years, with nyctalopia (night blindness) being the most frequent initial symptom in 92.9% of patients. Clinical presentations were diverse,

encompassing foveomacular schisis (41.1%), yellow-white dots (57.1%), nummular pigmentation (85.7%), torpedo-like lesions (10.7%), and circumferential subretinal fibrosis (7.1%) [3].

CONCLUSION

If there is a lack of knowledge of the disorder, the rarity of ESCS might make diagnosis difficult. In ESCS, the retina exhibits a wide range of structural and functional abnormalities. To establish an appropriate diagnosis, pathognomonic ERG is needed. Young-onset nyctalopia and nummular pigmented lesions in the retina should elicit suspicion and require more research. Since this ailment has a distinct prognosis from other phenotypically related conditions, it is crucial to recognise it.

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