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Lipid profile alterations in non-infectious uveitis: correlation with quantitative optical coherence tomography angiography parameters

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ABSTRACT

Background/aims Lipid profiles have been changed in numerous chronic conditions. The impact of uveitis on lipid metabolism remains unclear.

Methods This is a cross-sectional study included 416 patients with non-infectious uveitis (NIU) and 416 healthy subjects. Standard techniques were used to measure total cholesterol (TC), triglycerides (TG), high-density lipoprotein-cholesterol (HDLc), low-density lipoprotein-cholesterol (LDLc) levels. Quantitative optical coherence tomography angiography (OCTA) parameters were obtained from 500 eyes in each group. Correlation analysis examined the relationship between lipid profile and OCTA parameters.

Results Patients with NIU exhibited significantly elevated TC, TG and LDLc levels compared with controls (p=0.003; p<0.001; p<0.001, respectively). Subgroup analysis revealed that HDLc was significantly lower in Behçet's disease (p=0.024) compared with controls. Vascular density (VD) in the superficial capillary plexus (SCP), deep capillary plexus (DCP), choriocapillaris and optic disk were significantly decreased in NIU eyes (p<0.05, respectively) compared with controls. HDLc exhibited a significant negative correlation with VDs in the whole and parafovea SCP (r=−0.489, p=0.008; r=−0.480, p=0.0026, respectively), while LDLc showed a significant positive correlation with VDs in the whole and parafovea DCP in NIU patients (r=0.576, p=0.032; r=0.267, p=0.034, respectively).

Conclusions The lipid profile is altered in NIU, and there are correlations between HDLc and LDLc levels and VD as measured by OCTA. Lipid profile analysis may offer valuable insights into evaluating vascular and metabolic aspects of NIU.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Lipid profiles have been observed to undergo changes in numerous chronic inflammatory diseases. The impact of uveitis on lipid metabolism remains unclear.

WHAT THIS STUDY ADDS

⇒ The lipid profile is altered in non-infectious uveitis (NIU), and there are correlations between high-density lipoprotein-cholesterol, low-density lipoprotein-cholesterol levels and vascular density as measured by optical coherence tomography angiography (OCTA).

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Lipid profile analysis may offer valuable insights into evaluating vascular and metabolic aspects of NIU. OCTA presents a convenient, non-invasive and quantitative method for assessing and monitoring the compromised retinal microcirculation in patients with NIU.

INTRODUCTION

Uveitis, characterised by eye inflammation, can result from infection, injury, autoimmune disorders or inflammatory conditions. This condition involves inflammation of the uvea tract, encompassing the iris, ciliary body and choroid, as well as adjacent eye structures like the vitreous, retina, optic nerve and sclera.[1] Uveitis is classified anatomically into four types: anterior uveitis, intermediate uveitis, posterior uveitis and panuveitis. Additionally, based on aetiology, it can be categorised into three types: infectious, non-infectious and masquerade.[2] Non-infectious uveitis (NIU) can be the manifestation of systemic autoimmune disease. In China, the most common types of NIU include Behçet's disease (BD), Vogt-Koyanagi-Harada (VKH) disease and idiopathic panuveitis. Idiopathic panuveitis is an inflammation of all layers of the uvea with an unknown cause. VKH disease causes inflammation in the eyes, skin, hair and ears due to an autoimmune response. Symptoms include vision changes, eye pain, hearing loss, headaches and skin colour changes. BD is a chronic autoimmune disease causing recurrent inflammation in blood vessels throughout the body, affecting organs like the eyes, skin, joints and gut. Ocular BD presents as uveitis. Uveitis can be severe, potentially leading to permanent vision loss. Therefore, early diagnosis and treatment are essential for preventing complications and preserving vision.

Lipid profiles have been observed to undergo changes in numerous chronic inflammatory diseases.[3] Abnormal lipid metabolism and variations in the content and composition of membrane phospholipids have been identified in the blood of systemic lupus erythematosus patients when compared with individuals without the condition. Furthermore, investigations have revealed alterations in lipid content and composition among patients diagnosed with rheumatoid arthritis, inflammatory bowel disease, multiple sclerosis and type 1 diabetes mellitus.[4] Dyslipidaemia, as a significant contributing factor, can also expedite inflammation and atherosclerosis in autoimmune diseases.

Abnormalities in lipid parameters have also been reported in BD. Lessof *et al* discovered that BD-associated uveitis was correlated with serum high-density lipoprotein-cholesterol (HDLc) levels when compared with healthy controls.[5] Interestingly, it has also been reported that there were no significant differences in the concentrations of low-density lipoprotein-cholesterol (LDLc), total cholesterol (TC) and triglyceride (TG) between patients with BD and controls.[6] These lipid parameter abnormalities may elevate the risk of cardiovascular events in BD patients.[7] However, the proportion of BD-associated uveitis cases within the total uveitis population is very small, and more than 60% being idiopathic uveitis. The impact of uveitis on lipid metabolism remains unclear.

Optical coherence tomography angiography (OCTA) is an innovative, non-invasive imaging technique capable of visualising the 3D vasculature of the retina and choroid. This technology can identify both physiological and pathological blood flow abnormalities, which are particularly relevant in uveitis cases.[8] OCTA has demonstrated its advantage in diagnosing and monitoring choroidal involvement in uveitis, including conditions such as acute posterior multifocal placoid pigment epitheliopathy,[9] multifocal choroiditis,[10] birdshot chorioretinopathy,[11] acute macular neuroretinopathy.[12] Furthermore, OCTA allows for the quantification of microvascular changes in the retinal capillary network, in addition to detecting classical uveitis features. Some studies have reported that OCTA can provide quantitative analysis for VKH disease.[13] While previous retinal studies have shown associations between serum lipid profiles, dyslipidaemia and retinal microvascular changes,[14] the assessment of retinal and choroidal microvasculature in NIU and its correlation with systemic biomarkers, such as lipid profiles, remains unexplored.

The aim of this study was to evaluate the lipid profile in NIU and provide guidance for its treatment. This study involved the assessment of serum lipids in NIU, including BD-associated uveitis, VKH disease and idiopathic uveitis cases. OCTA was used to measure vascular density (VD) in the superficial capillary plexus (SCP), deep capillary plexus (DCP), outer retinal circulation and choriocapillaris. The relationship between serum lipids and OCTA parameters was examined.

METHODS

Inclusion criteria

NIU cases were identified in accordance with the revised international criteria of the American Uveitis Society, employing a range of clinical examination techniques, including slit-lamp examination, fundus examination, OCTA, fluorescein angiography, and if deemed necessary, indocyanine green angiography. Laboratory examinations, including a routine blood test, blood biochemistry indexes, and liver and kidney function indexes, were conducted. Serological investigations for syphilis, along with tuberculin tests, were conducted to ascertain the underlying aetiology of uveitis. The patients had not taken corticosteroids, immunosuppressants or statins. The analysis incorporated either one or two uveitic eyes per patient. In parallel, during the same study period, age-matched healthy volunteers devoid of any history of ocular inflammation, ocular injury, ocular surgery or notable ocular pathologies were recruited. One or two eyes from each healthy volunteer were included in the analysis.

We conducted a retrospective review of medical records for both the patients and the normal controls, encompassing variables such as sex, age, uveitis diagnosis and OCTA images.

Exclusion criteria

Exclusions were made for individuals with infectious uveitis, diabetic retinopathy, retinal vascular occlusion, age-related macular degeneration, masquerade syndrome, glaucoma and high myopia. Additionally, individuals with obesity, hyperlipidaemia, heart disease, diabetes, hypothyroidism, chronic kidney disease, metabolic syndrome, liver diseases were excluded from the study. Food frequency questionnaires were conducted, and individuals following extreme low-carbohydrate or high-fat diets were excluded from the study. People with unhealthy lifestyle habits, including smoking, excessive drinking and chronic stress, were excluded from the study. Subjects who exhibited inability to maintain fixation or presented significant media opacities were also excluded. Furthermore, OCTA images characterised by suboptimal quality, including projection artefacts originating from vessels positioned above the imaging plane or excessively dark images featuring extremely thick outer choroidal vessels, were subject to exclusion.

Biochemical assays

Blood was collected, and serum was obtained by centrifugation of the clotted blood. Blood TC, TG, HDLc, LDLc levels, blood glucose (GLU), blood urea nitrogen (BUN), creatinine (Cr), uric acid (UA) and C reactive protein (CRP) levels were measured using an Ortho Clinical Diagnostics VITROS 950 automated analyzer (Johnson & Johnson, New Brunswick, NJ, USA).

OCTA image analysis

All subjects, including both patients and normal controls, underwent imaging using the AngioVue Imaging System

(RTVue XR Avanti; Optovue, Fremont, CA). OCTA image analysis encompassed two specific regions: a 4.5 mm×4.5 mm area centred on the papilla and a 6 mm×6 mm area centred on the fovea. Additionally, a customised function within the AngioVue software (V.2018.1.0.43; Optovue) was employed for the measurement of FD-300 and VD across various anatomical structures, including the optic disk, SCP, DCP, outer retina and choriocapillaris. Within the 6 mm×6 mm macular scan, concentric circles with diameters of 1 mm and 6 mm were delineated, designating the inner circle as the fovea and the region between the two circles as the parafovea.

Statistical analysis

Statistical analysis was conducted with SPSS statistical software (IBM Corp, Armonk, NY). Continuous data are presented as the mean±SD. To compare the two groups, we used the unpaired t-test and the Mann-Whitney U test. Categorical variables were compared using the χ^2 test, and Pearson's correlation analysis was employed to evaluate the relationships among variables. Statistical significance was defined as a p value less than 0.05.

RESULTS

Clinical and demographic characteristics

A total of 416 patients with NIU, consisting of 248 females and 168 males, corresponding to 500 eyes, were included. The mean age of these participants was 43.68±15.68 years. Additionally, 416 age-matched control subjects (246 females and 170 males, totalling 500 eyes) with a mean age of 45.66±18.18 years were included for comparison. No statistically significant differences were observed between the uveitis patients and the control group in terms of age and sex (p=0.561, p=0.944, respectively). Table 1 summarises the demographic, anthropometric and laboratory characteristics of both the uveitis and control groups. In the uveitis group, there were 351 cases of idiopathic panuveitis (n=351; 84.4%), 25 cases of VKH disease (n=25; 6.0%), 25 cases of BD-associated uveitis (n=25; 6.0%), 5 cases of scleritis (n=5; 1.2%), 5 cases of Fuchs syndrome (n=5; 1.2%) and 5 cases of choroiditis (n=5; 1.2%).

Laboratory characteristics of uveitis

Table 1 presents serum lipid levels (TC, TG, HDLc, LDLc) and other mean laboratory values, including GLU, BUN, Cr, UA and CRP. Uveitis patients exhibited significantly elevated levels of TC, TG and LDLc compared with the controls (p=0.003; p<0.001; p<0.001, respectively), while HDLc, GLU, BUN, Cr, UA and CRP levels remained statistically unchanged. Subgroup analysis was performed among patients with idiopathic panuveitis, VKH disease, BD-associated uveitis and normal controls. In online supplemental table 1, as compared with the controls, both the idiopathic panuveitis and VKH disease groups showed significantly increased TC, TG and LDLc levels (p<0.05), whereas HDLc and CRP levels remained unchanged (p>0.05). In contrast, compared with the idiopathic panuveitis, VKH disease and normal control groups, the BD-associated uveitis group exhibited a statistically significant decrease in HDLc levels (p=0.024) and an increase in CRP levels (p<0.001). There were no statistical differences in the levels of GLU, BUN, Cr, UA among all the groups.

Correlation among biological parameters in the uveitis

Online supplemental table 2 displays the correlation analyses between various laboratory values in uveitis patients. GLU was negatively correlated with HDLc (r=−0.251, p<0.0001). Additionally, BUN showed a positive

Table 1 Demographic, anthropometric and laboratory characteristics of uveitis and control groups

Parameter	Uveitis (n=416)	Control (n=416)	P value
Age (year)	43.68±15.68	45.66±18.18	0.561
Male/Female	168/248	170/246	–
Sex ratio (%)	40.38	40.86	0.944
GLU (mmol/L)	5.30±0.40	5.25±0.81	0.236
BUN (mmol/L)	5.15±1.27	4.64±1.06	0.064
Cr (μmol/L)	70.02±12.88	69.76±17.69	0.225
UA (μmol/L)	296.80±60.46	304.50±54.74	0.107
TC (mmol/L)	5.28±1.19	5.02±0.88	**0.003**
TG (mmol/L)	1.72±1.11	1.45±0.81	**<0.001**
HDLc (mmol/L)	1.50±0.36	1.48±0.37	0.205
LDLc (mmol/L)	3.30±0.88	2.70±0.65	**<0.001**
CRP (mg/L)	1.70±1.84	1.54±2.35	0.752

The data were presented as mean±SD.
Bolded P values denote statistical significance
BUN, blood urea nitrogen; Cr, creatinine; CRP, C reactive protein; GLU, blood glucose; HDLc, high-density lipoprotein-cholesterol; LDLc, low-density lipoprotein-cholesterol; TC, total cholesterol; TG, triglyceride; UA, uric acid.

Table 2 The value and comparison of VD in the uveitis and control groups

	Uveitis	Control	P value
Whole VD SCP (%)	46.04±5.04	48.97±3.88	**<0.001**
Parafovea VD SCP (%)	46.70±5.32	50.62±5.29	**<0.001**
Whole VD DCP (%)	45.71±5.28	48.25±6.60	**0.019**
Parafovea VD DCP (%)	51.77±5.80	54.01±4.62	**0.018**
Whole VD outer retina (%)	14.79±3.78	14.69±3.14	0.873
Whole VD choriocapillaris (%)	23.60±1.51	24.21±1.18	**0.012**
FAZ (mm^2)	0.31±0.08	0.33±0.13	0.248
FD-300 area density (%)	46.85±7.66	54.03±5.70	**<0.001**
FD-300 length density (%)	9.92±2.75	11.54±2.29	**<0.001**
Optic disk VD (%)	53.15±5.57	56.35±2.43	**<0.001**

The data were presented as mean±SD.

DCP, deep capillary plexus; FAZ, foveal avascular zone; FD-300, foveal density 300 µm; SCP, superficial capillary plexus; VD, vascular density.

association with Cr (r=0.287, p<0.0001) and UA (r=0.145, p<0.01). UA also exhibited correlations with BUN, Cr and CRP. Moreover, TC was significantly correlated with TG and LDLc (TG: r=0.375, p<0.0001; LDLc: r=0.944, p<0.0001, respectively). Similarly, TG was significantly associated with TC and LDLc (TC: r=0.375, p<0.0001; LDLc: r=0.354, p<0.0001, respectively). However, HDLc did not show any significant associations with TC, TG or LDLc (all p>0.05). Subgroup analysis were performed in patients with idiopathic panuveitis (online supplemental table 3), VKH disease (online supplemental table 4), BD-associated uveitis (online supplemental table 5). In patients with idiopathic panuveitis and BD-associated uveitis, TC was significantly correlated with TG , HDLc and LDLc. BUN showed a positive association with Cr in patients with VKH disease.

Comparison of VD in the uveitis and control groups

Table 2 presents a summary of vascular densities in the SCP, DCP, optic disc, outer retina and choriocapillaris for both eyes affected by uveitis and those from the normal control group. Within the SCP, VD values were recorded at 46.04±5.04 in the whole image and 46.70±5.32 in the parafoveal region for uveitis eyes, while in control eyes, these values were 48.97±3.88 and 50.62±5.29, respectively. In the DCP, VD measurements were 45.71±5.28 for the whole image and 51.77±5.80 in the parafoveal region for uveitis eyes, compared with 48.97±3.88 and 54.01±4.62 in normal eyes, respectively. The VD of the outer retina was found to be 14.79±3.78 in uveitis eyes and 14.69±3.14 in control eyes, and no statistically significant difference was observed between the two groups (p=0.826). Likewise, the choriocapillaris VD was recorded at 23.60±1.51 in uveitis eyes and 24.21±1.18 in control eyes. The optic disk's VD was measured at 53.15±5.57 in uveitis eyes and 56.35±2.43 in control eyes. Notably, statistical analysis revealed a significant reduction in VDs in the whole image of SCP, parafoveal region of SCP, whole image of DCP, parafoveal region of DCP, choriocapillaris, FD-300 area density, FD-300 length density and the optic disk, in uveitis eyes compared with control eyes (p<0.001, p<0.001, p=0.019, p=0.018, p=0.012, p<0.001, p<0.001, p<0.001, respectively). However, no significant difference in VD in the outer retina and foveal avascular zone (FAZ) area was found when comparing uveitis-affected eyes to control eyes (p=0.873, p=0.248, respectively). Subgroup analysis were performed in patients among idiopathic panuveitis, VKH disease, BD-associated uveitis (online supplemental table 6). VDs in the SCP, DCP, choriocapillaris, FD-300 area density, FD-300 length density and optic disk were significantly decreased in idiopathic panuveitis, VKH disease, BD-associated uveitis (p<0.05, respectively) compared with controls, but there were no significant differences among these three groups.

Correlation between biological parameters and VD in the uveitis

Correlation analyses between quantitative parameters from OCTA and laboratory values are presented in online supplemental table 7. In uveitis eyes, UA and HDLc exhibited statistically significant negative correlations with VDs of the whole SCP (UA: r=−0.413, p=0.021; HDLc: r=−0.489, p=0.008, respectively). Additionally, HDLc displayed a negative association with parafovea SCP (r=−0.480, p=0.026). LDLc showed a significant positive correlation with VDs in both the whole and parafovea DCP (r=0.576, p=0.032; r=0.267, p=0.034, respectively). Both the whole image and parafovea DCP exhibited negative associations with GLU and BUN (p<0.05). VDs in the choriocapillaris and optic disk were significantly correlated with BUN (p=0.006, p=0.005, respectively). However, VDs in the outer retina, FD-300 area density and FD-300 length density showed no significant associations with any of the laboratory values (all p>0.05).

DISCUSSION

The present study demonstrated that TC, TG and LDLc were elevated in patients with NIU when compared with healthy controls. Although the precise pathogenesis of NIU remains unknown, it is believed to involve a T cell-mediated autoimmune response initiated by inflammation and directed against retinal or cross-reactive antigens.[15] Subgroup analysis was performed among individuals with idiopathic panuveitis, VKH disease, BD-associated with uveitis and normal controls. Interestingly, when compared with idiopathic panuveitis, VKH disease, and normal controls, HDLc exhibited a significant decrease, while TC, TG and LDLc showed no significant changes. Additionally, CRP levels were significantly increased in individuals with BD-associated uveitis.

The interaction of CRP with complement C1 and FcγR enables it to manifest a variety of biological activities, including participating in the host's defence response to infection, facilitating phagocytosis and modulating the inflammatory response.[16] Notably, CRP has been employed as an indicator of disease activity in BD, with reports indicating significantly higher CRP levels in BD patients compared with control subjects.[17] Hence, in alignment with previous studies, elevated CRP levels indicate that BD constitutes a systemic inflammatory response and can serve as a marker of disease activity. The CRP level holds potential as a serum biomarker for BD. Elevated CRP levels in BD may ultimately contribute to the exacerbation of the inflammatory cascade and heightened secretion of pro-inflammatory cytokines, specifically Th1-related and Th17-related cytokines.

Our findings align with the majority of previous studies indicating lower levels of HDLc in BD. HDLc possesses anti-inflammatory properties and is primarily synthesised by the liver. It consists of phospholipids, apolipoproteins, cholesterol and a small quantity of fatty acids. Its primary physiological role is to transport phospholipids and cholesterol, thereby removing cholesterol from peripheral blood vessels, contributing to cardiovascular protection. Our results suggest that reduced HDLc levels may serve as a predictive factor for increased susceptibility to atherosclerosis in BD. However, it is essential to acknowledge that discrepancies in study design and sample populations exist, and our results contradict a single study that documented elevated HDL levels in BD.[6]

We conducted correlation analyses among various laboratory values in uveitis. A significant correlation between GLU and HDLc was observed, indicating a certain relationship between abnormal lipid metabolism and glucose metabolism in uveitis. Additionally, as anticipated, UA exhibited correlations with BUN, Cr and CRP, while TC demonstrated correlations with TG and LDLc. Our findings strongly suggest the presence of abnormal lipid metabolism in uveitis. Notably, the specific type of uveitis appears to influence the extent of lipid metabolism alterations based on the underlying cause of the disease. Therefore, it is imperative to closely monitor these abnormal indicators in clinical practice, as they may bear relevance to disease activity and prognosis.

In recent years, OCTA has gained widespread usage due to its non-invasive, rapid and high-resolution technology. It enables the visualisation of retinal and choroidal blood vessel morphology and structure at various levels without the need for contrast agents, allowing for the quantification of blood flow density.[18] In our current study, quantitative analysis using OCTA revealed a significant reduction in VDs in both the whole and parafoveal SCP and DCP in patients with NIU compared with healthy controls. Additionally, VDs in various regions, including the optic disc, the area within 300 µm around the FAZ, and the choriocapillaris, were decreased significantly in the uveitis group compared with the control group. These findings are consistent with previous research in BD-associated with uveitis, VKH disease and birdshot chorioretinopathy, which also reported decreased VDs in SCP and DCP.[19–21] Furthermore, an enlarged FAZ area is indicative of more severe vascular dysfunction. In our study, we observed a trend toward an increased FAZ area, although the difference was not statistically significant between the uveitis and control groups. This could be attributed to significant individual variations in FAZ area among healthy individuals, partly influenced by factors such as ocular axis.[22] Collectively, these results suggest that the decrease in VD may be attributed to the inflammatory response associated with uveitis.

In our study, HDLc exhibited a significant negative correlation with VDs in both the whole and parafoveal SCP ($r=-0.489$, $p<0.01$; $r=-0.480$, $p<0.01$, respectively), whereas LDLc demonstrated a significant positive correlation with VDs in both the whole and parafoveal DCP in patients with NIU ($r=0.576$, $p=0.032$; $r=0.267$, $p=0.034$, respectively). However, we did not find any significant correlations between VDs in the outer retina, FD-300 area density, FD-300 length density and any of the laboratory values assessed. The limited availability of previously published data on the correlation between blood flow and blood lipids makes it challenging to compare our results with prior research. It is noteworthy that retinal microvascular abnormalities are closely linked to inflammation and vascular endothelial dysfunction. Dyslipidaemia may exacerbate the inflammatory response, thereby worsening endothelial damage. Conversely, inflammation may also influence lipid metabolism, including the synthesis, degradation of blood lipids, and adipocyte differentiation and function. Recent studies have suggested that triglycerides can induce toxicity and activate the body's innate immune system, setting off a cascade of destructive processes, including arterial wall damage, vessel blockage and impaired blood flow.[23] Hence, lipid metabolism may play a pivotal role in the alterations observed in ocular microcirculation in uveitis patients. Consequently, our study aimed to explore the correlation between blood lipid levels and blood flow density in uveitis patients. Previous studies have also indicated that macular VD measured through OCTA could serve as a diagnostic biomarker for systemic diseases such as Alzheimer's disease.[24] Our study provides evidence

of a discernible correlation between blood flow density and lipid levels in NIU. These two indicators hold promise as valuable diagnostic and therapeutic adjuncts in the management of NIU.

Our study has several limitations. First, it is a cross-sectional study, and our sample size was constrained due to strict inclusion and exclusion criteria. Prior research has indicated that glucocorticoids can potentially alter various metabolic pathways, which might introduce confounding factors affecting differences between uveitis patients and controls.[25] In our study, none of the subjects had been using these drugs for extended periods. In the future, we could consider expanding the sample size to include individuals both using and not using glucocorticoids to investigate their impact on lipid levels in NIU. Additionally, it would be valuable to stratify subjects based on different regions, gender, age and nutritional status for further analysis.

In conclusion, our study reveals that the lipid profile is altered in NIU, with elevated levels of TC, TG and LDLc in NIU patients. Interestingly, LDLc was found to be decreased in BD associated with uveitis. The alterations in retinal capillary VD were also observed, and these changes in retinal VD demonstrated a significant correlation with HDLc and LDLc. OCTA presents a convenient, non-invasive and quantitative method for assessing and monitoring the compromised retinal microcirculation in patients with NIU.

Contributors LF contributed to the study conception and design. Material preparation, data collection and analysis were performed by JS and GQ. The first draft of the manuscript was written by JS. LF supervised the project and acted as the guarantor.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Consent obtained directly from patient(s).

Ethics approval This study involves human participants. This prospective, cross-sectional study was approved by the Institutional Review Board of the Second Affiliated Hospital of Zhejiang University School of Medicine (20230615). The consent procedure and study protocol followed the tenets of the Declaration of Helsinki. Patients diagnosed with non-infectious panuveitis and normal controls between May 2022 and May 2023 were enrolled. Written informed consent was obtained.

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Data availability statement Data are available upon reasonable request.

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REFERENCES

1 Shen J, Su Z, Feng L. Sarcoid uveitis: a case report and systematic review of literature. *Adv Ophthalmol Pract Res* 2022;2:100047.
2 Deschenes J, Murray PI, Rao NA, *et al*. International uveitis study group (IUSG): clinical classification of uveitis. *Ocul Immunol Inflamm* 2008;16:1–2.
3 Lahita RG, Rivkin E, Cavanagh I, *et al*. Low levels of total cholesterol, high-density lipoprotein, and apolipoprotein A1 in association with Anticardiolipin antibodies in patients with systemic lupus erythematosus. *Arthritis Rheum* 1993;36:1566–74.
4 Wang Y, Yu H, He J. Role of dyslipidemia in accelerating inflammation, autoimmunity, and atherosclerosis in systemic lupus erythematosus and other autoimmune diseases. *Discov Med* 2020;30:49–56.
5 Lessof MH, Jefferys DB, Lehner T, *et al*. Corticosteroids and azathioprine: their use in Behet's syndrome. 1979.
6 Tursen U, Eskandari G, Kaya TI, *et al*. Apolipoprotein E polymorphism and lipoprotein compositions in patients with behcet's disease. *Int J Dermatol* 2004;43:900–3.
7 Coskun B, Saral Y, Gödekmerdan A, *et al*. Activation markers in behcet's disease. *Skinmed* 2005;4:282–6.
8 Pichi F, Hay S. Use of optical coherence tomography angiography in the uveitis clinic. *Graefes Arch Clin Exp Ophthalmol* 2023;261:23–36.
9 Klufas MA, Phasukkijwatana N, Iafe NA, *et al*. Optical coherence tomography angiography reveals choriocapillaris flow reduction in placoid chorioretinitis. *Ophthalmol Retina* 2017;1:77–91.
10 Zahid S, Chen KC, Jung JJ, *et al*. Optical coherence tomography angiography of chorioretinal lesions due to idiopathic multifocal choroiditis. *Retina* 2017;37:1451–63.
11 Pichi F, Sarraf D, Arepalli S, *et al*. The application of optical coherence tomography angiography in uveitis and inflammatory eye diseases. *Prog Retin Eye Res* 2017;59:178–201.
12 Thanos A, Faia LJ, Yonekawa Y, *et al*. Optical coherence tomographic angiography in acute macular neuroretinopathy. *JAMA Ophthalmol* 2016;134:1310–4.
13 Liang A, Jia S, Gao F, *et al*. Decrease of choriocapillary vascular density measured by optical coherence tomography angiography in vogt-koyanagi-harada disease. *Graefes Arch Clin Exp Ophthalmol* 2021;259:3395–404.
14 Xiao W, Guo X, Ding X, *et al*. Serum lipid profiles and dyslipidaemia are associated with retinal microvascular changes in children and adolescents. *Sci Rep* 2017;7:44874.
15 Prete M, Dammacco R, Fatone MC, *et al*. Autoimmune uveitis: clinical, pathogenetic, and therapeutic features. *Clin Exp Med* 2016;16:125–36.
16 Pope JE, Choy EH. C-reactive protein and implications in rheumatoid arthritis and associated comorbidities. *Semin Arthritis Rheum* 2021;51:219–29.
17 Vayá A, Rivera L, Todolí J, *et al*. Haematological, biochemical and inflammatory parameters in inactive behcet's disease. its association with red blood cell distribution width. *Clin Hemorheol Microcirc* 2014;56:319–24.
18 Wassef AMA, Abdelhakim MASE, Macky TA, *et al*. Post-remission retinal microvascular and choroidal thickness changes in eyes with behcet's disease posterior uveitis: an OCTA longitudinal study. *Int Ophthalmol* 2021;41:4163–74.
19 Liang A, Zhao C, Jia S, *et al*. Retinal microcirculation defects on OCTA correlate with active inflammation and vision in vogt-koyanagi-harada disease. *Ocul Immunol Inflamm* 2021;29:1417–23.
20 Koca S, Onan D, Kalaycı D, *et al*. Comparison of optical coherence tomography angiography findings in patients with behcet's disease and healthy controls. *Ocul Immunol Inflamm* 2020;28:806–13.
21 Roberts PK, Nesper PL, Goldstein DA, *et al*. Retinal capillary density in patients with birdshot chorioretinopathy. *Retina* 2018;38:387–94.
22 Mammo Z, Balaratnasingam C, Yu P, *et al*. Quantitative noninvasive angiography of the fovea centralis using speckle variance optical coherence tomography. *Invest Ophthalmol Vis Sci* 2015;56:5074–86.
23 Zewinger S, Reiser J, Jankowski V, *et al*. Apolipoprotein C3 induces inflammation and organ damage by alternative inflammasome activation. *Nat Immunol* 2020;21:30–41.
24 Wang X, Wang Y, Liu H, *et al*. Macular microvascular density as a diagnostic biomarker for alzheimer's disease. *J Alzheimers Dis* 2022;90:139–49.
25 Bouillet B, Gautier T, Denimal D, *et al*. Glucocorticoids impair HDL-mediated cholesterol efflux besides increased HDL cholesterol concentration: a proof of concept. *Eur J Endocrinol* 2020;183:297–306.

SUPPLEMENTARY DATA

Supplementary Table S1. subgroup analysis of laboratory characteristics of uveitis

Parameter	Idiopathic panuveitis	VKH disease	Behçet's disease	Control	p-value*	p-value**	p-value***	p-value#	p-value##
GLU (mmol/L)	5.23 ± 0.37	5.35 ± 0.37	5.24 ± 0.45	5.25 ± 0.81	0.709	0.419	0.903	0.159	0.939
BUN (mmol/L)	4.65 ± 0.91	4.74 ± 0.76	4.51 ± 1.29	4.64 ± 1.06	0.954	0.753	0.732	0.706	0.542
Cr (umol/L)	69.44 ± 12.59	63.77 ± 9.77	73.71 ± 12.65	69.76 ± 17.69	0.775	0.093	0.324	0.058	0.143
UA (umol/L)	296.11 ± 58.91	289.12 ± 58.11	302.31 ± 68.13	304.50 ± 54.74	0.054	0.151	0.731	0.597	0.679
TC (mmol/L)	5.26 ± 1.12	5.40 ± 0.54	4.67 ± 0.88	5.02 ± 0.88	**<0.001**	**0.033**	0.075	**0.017**	**<0.001**
TG (mmol/L)	1.65 ± 1.02	2.58 ± 1.41	1.30 ± 0.79	1.45 ± 0.81	**<0.001**	**<0.001**	0.408	0.125	**<0.001**
HDL (mmol/L)	1.51 ± 0.35	1.57 ± 0.52	1.29 ± 0.37	1.48 ± 0.37	0.109	0.257	**0.024**	**0.005**	**0.045**
LDL (mmol/L)	3.30 ± 0.81	2.99± 0.67	2.82 ± 0.72	2.70 ± 0.65	**<0.001**	**0.047**	0.458	**0.011**	0.421
CRP (mg/L)	1.71 ± 1.86	1.02 ± 0.89	31.10 ± 26.30	1.54 ± 2.35	0.734	0.376	**<0.001**	**<0.001**	**<0.001**

The data were presented as mean ± SD. SD, standard deviation; GLU, blood glucose; BUN, blood urea nitrogen; Cr, creatinine; UA, uric acid; TC, total cholesterol; TG, triglyceride; HDLc, high-density lipoprotein-cholesterol; LDLc, low-density lipoprotein-cholesterol; CRP, C-reactive protein. *Difference between Idiopathic panuveitis and normal controls, **difference between VKH disease and normal controls, ***difference between Behçet's disease and normal controls. #Difference between Idiopathic panuveitis and Behçet's disease, ## difference between VKH disease and Behçet's disease

Supplementary Table S2. Corretation among biological parameters in the uveitis

	GLU	BUN	Cr	UA	TC	TG	HDL	LDL	CRP
		r=0.015;	r=0.060;	r=0.021;	r=0.065;	r=0.004;	r=-0.251;	r=0.092;	r=0.028;
GLU	/	p=0.777	p=0.273	p=0.716	p=0.224	p=0.947	**p<0.001**	p=0.082	p=0.609
	r=0.015;		r=0.287;	r=0.145;	r=0.090;	r=0.012;	r=-0.073;	r=0.082;	r=0.012;
BUN	p=0.777	/	**p<0.001**	**p=0.009**	p=0.074	p=0.816	p=0.153	p=0.104	p=0.812
	r=0.060;	r=0.287;		r=0.383;	r=0.079;	r=-0.053;	r=0.059;	r=0.071;	r=0.097;
Cr	p=0.273	**p<0.001**	/	**p<0.001**	p=0.118	p=0.299	p=0.244	p=0.164	p=0.062
	r=0.021;	r=0.145;	r=0.383;		r=0.002;	r=-0.056;	r=0.070;	r=0.030;	r=0.159;
UA	p=0.716	**p=0.009**	**p<0.001**	/	p=0.967	p=0.297	p=0.197	p=0.578	**p=0.004**
	r=0.065;	r=0.090;	r=0.079;	r=0.002;		r=0.375;	r=0.082;	r=0.944;	r=0.002;
TC	p=0.224	p=0.074	p=0.118	p=0.967	/	**p<0.001**	p=0.073	**p<0.001**	p=0.971
	r=0.004;	r=0.012;	r=-0.053;	r=-0.056;	r=0.375;		r=-0.039;	r=0.354;	r=0.037;
TG	p=0.947	p=0.816	p=0.299	p=0.297	**p<0.001**	/	p=0.387	**p<0.001**	p=0.471
	r=-0.251;	r=-0.073;	r=0.059;	r=0.070;	r=0.082;	r=-0.039;		r=0.042;	r=-0.010;
HDL	**p<0.001**	p=0.153	p=0.244	p=0.197	p=0.073	p=0.387	/	p=0.361	p=0.845
	r=0.092;	r=0.082;	r=0.071;	r=0.030;	r=0.944;	r=0.354;	r=0.042;		r=0.020;
LDL	p=0.082	p=0.104	p=0.164	p=0.578	**p<0.001**	**p<0.001**	p=0.361	/	p=0.691
	r=0.028;	r=0.012;	r=0.097;	r=0.159;	r=0.002;	r=0.037;	r=-0.010;	r=0.020;	
CRP	p=0.609	p=0.812	p=0.062	**p=0.004**	p=0.971	p=0.471	p=0.845	p=0.691	/

GLU, blood glucose; BUN, blood urea nitrogen; Cr, creatinine; UA, uric acid; TC, total cholesterol; TG, triglyceride; HDLc, high-density lipoprotein-cholesterol; LDLc, low-density lipoprotein-cholesterol; CRP, C-reactive protein.

Supplementary Table S3. Corretation among biological parameters in the Idiopathic panuveitis

	GLU	BUN	Cr	UA	TC	TG	HDL	LDL	CRP
		r=0.161;	r=0.089;	r=0.049;	r=0.051;	r=0.117;	r=-0.089;	r=0.092;	r=-0.061;
GLU	/	**p=0.002**	p=0.091	p=0.345	p=0.335	**p=0.026**	p=0.087	p=0.079	p=0.242
	r=0.161;		r=0.336;	r=0.102;	r=0.151;	r=0.028;	r=-0.028;	r=0.125;	r=-0.009;
BUN	**p=0.002**	/	**p<0.001**	**p=0.042**	**p=0.002**	p=0.579	p=0.567	**p=0.012**	p=0.842
	r=0.089;	r=0.336;		r=0.468;	r=-0.018;	r=0.017;	r=-0.026;	r=0.006;	r=0.049;
Cr	p=0.091	**p<0.001**	/	**p<0.001**	p=0.716	p=0.738	p=0.598	p=0.899	p=0.323
	r=0.049;	r=0.102;	r=0.468;		r=-0.052;	r=-0.011;	r=0.055;	r=-0.002;	r=-0.035;
UA	p=0.345	**p=0.042**	**p<0.001**	/	p=0.299	p=0.819	p=0.268	p=0.964	p=0.485
	r=0.051;	r=0.151;	r=-0.018;	r=-0.052;		r=0.141;	r=0.183;	r=0.332;	r=0.059;
TC	p=0.335	**p=0.002**	p=0.716	p=0.299	/	**p=0.002**	**p<0.001**	**p<0.001**	p=0.234
	r=0.117;	r=0.028;	r=0.017;	r=-0.011;	r=0.141;		r=-0.005;	r=0.207;	r=0.129;
TG	**p=0.026**	p=0.579	p=0.738	p=0.819	**p=0.002**	/	p=0.916	**p<0.001**	p=0.059
	r=-0.089;	r=0.028;	r=-0.026;	r=0.055;	r=0.183;	r=-0.005;		r=0.079;	r=-0.077;
HDL	p=0.087	p=0.567	p=0.598	p=0.268	**p<0.001**	p=0.916	/	p=0.085	p=0.121
	r=0.092;	r=0.125;	r=0.006;	r=-0.002;	r=0.332;	r=0.207;	r=0.079;		r=-0.020;
LDL	p=0.079	**p=0.012**	p=0.899	p=0.964	**p<0.001**	**p<0.001**	p=0.085	/	p=0.689
	r=-0.061;	r=-0.009;	r=0.049;	r=-0.035;	r=0.059;	r=0.129;	r=-0.077;	r=-0.019;	
CRP	p=0.242	p=0.842	p=0.323	p=0.485	p=0.235	p=0.059	p=0.121	p=0.689	/

GLU, blood glucose; BUN, blood urea nitrogen; Cr, creatinine; UA, uric acid; TC, total cholesterol; TG, triglyceride; HDLc, high-density lipoprotein-cholesterol; LDLc, low-density lipoprotein-cholesterol; CRP, C-reactive protein.

Supplementary Table S4. Corretation among biological parameters in the VKH disease

	GLU	BUN	Cr	UA	TC	TG	HDL	LDL	CRP
		r=0.078;	r=0.027;	r=-0.265;	r=0.179;	r=-0.416;	r=-0.182;	r=0.186;	r=-0.171;
GLU	/	p=0.694	p=0.891	p=0.182	p=0.393	p=0.068	p=0.429	p=0.433	p=0.472
	r=0.078;		r=0.669;	r=0.201;	r=0.216;	r=-0.144;	r=0.171;	r=0.108;	r=0.102;
BUN	p=0.694	/	**p<0.001**	p=0.314	p=0.301	p=0.545	p=0.461	p=0.649	p=0.669
	r=0.027;	r=0.669;		r=0.067;	r=0.259;	r=-0.085;	r=0.064;	r=0.069;	r=0.381;
Cr	p=0.891	**p<0.001**	/	p=0.741	p=0.211	p=0.721	p=0.784	p=0.771	p=0.098
	r=-0.265;	r=0.201;	r=0.067;		r=-0.027;	r=0.248;	r=-0.072;	r=-0.126;	r=-0.235;
UA	p=0.182	p=0.314	p=0.741	/	p=0.897	p=0.291	p=0.756	p=0.597	p=0.318
	r=0.179;	r=0.216;	r=0.259;	r=-0.027;		r=-0.136;	r=-0.409;	r=0.166;	r=0.028;
TC	p=0.393	p=0.301	p=0.211	p=0.897	/	p=0.567	p=0.066	p=0.484	p=0.907
	r=-0.416;	r=-0.144;	r=-0.085;	r=0.248;	r=-0.137;		r=0.281;	r=0.093;	r=-0.184;
TG	p=0.068	p=0.545	p=0.721	p=0.291	p=0.567	/	p=0.229	p=0.697	p=0.438
	r=-0.182;	r=0.170;	r=0.064;	r=-0.072;	r=-0.409;	r=0.282;		r=0.091;	r=-0.073;
HDL	p=0.429	p=0.461	p=0.784	p=0.756	p=0.066	p=0.229	/	p=0.702	p=0.759
	r=0.186;	r=0.108;	r=0.069;	r=-0.126;	r=0.166;	r=0.093;	r=0.091;		r=0.244;
LDL	p=0.433	p=0.649	p=0.771	p=0.597	p=0.484	p=0.697	p=0.702	/	p=0.299
	r=-0.171;	r=0.102;	r=0.380;	r=-0.235;	r=0.028;	r=-0.184;	r=-0.073;	r=0.244;	
CRP	p=0.472	p=0.669	p=0.098	p=0.318	p=0.907	p=0.438	p=0.759	p=0.299	/

GLU, blood glucose; BUN, blood urea nitrogen; Cr, creatinine; UA, uric acid; TC, total cholesterol; TG, triglyceride; HDLc, high-density lipoprotein-cholesterol; LDLc, low-density lipoprotein-cholesterol; CRP, C-reactive protein.

Supplementary Table S5. Corretation among biological parameters in the Behçet's disease

	GLU	BUN	Cr	UA	TC	TG	HDL	LDL	CRP
		r=0.005;	r=0.038;	r=0.068;	r=-0.426;	r=-0.204;	r=-0.385;	r=-0.261;	r=0.193;
GLU	/	p=0.982	p=0.873	p=0.775	p=0.061	p=0.388	p=0.094	p=0.266	p=0.414
	r=0.005;		r=0.439;	r=0.487;	r=0.051;	r=0.176;	r=-0.161;	r=0.086;	r=-0.215;
BUN	p=0.982	/	p=0.053	**p=0.029**	p=0.832	p=0.458	p=0.496	p=0.718	p=0.362
	r=0.038;	r=0.439;		r=0.671;	r=0.140;	r=-0.036;	r=-0.132;	r=0.189;	r=-0.185;
Cr	p=0.873	p=0.053	/	**p=0.001**	p=0.557	p=0.879	p=0.579	p=0.426	p=0.434
	r=0.068;	r=0.487;	r=0.671;		r=0.102;	r=0.183;	r=-0.207;	r=0.152;	r=-0.063;
UA	p=0.775	**p=0.029**	**p=0.001**	/	p=0.670	p=0.440	p=0.381	p=0.522	p=0.793
	r=-0.426;	r=0.051;	r=0.140;	r=0.102;		r=0.548;	r=0.358;	r=0.957;	r=-0.527;
TC	p=0.061	p=0.832	p=0.557	p=0.670	/	**p=0.012**	**p=0.022**	**p<0.001**	p=0.057
	r=-0.204;	r=0.176;	r=-0.036;	r=0.183;	r=0.548;		r=-0.336;	r=0.573;	r=-0.297;
TG	p=0.388	p=0.458	p=0.879	p=0.440	**p=0.012**	/	p=0.147	**p=0.008**	p=0.204
	r=-0.385;	r=-0.162;	r=-0.132;	r=-0.207;	r=0.358;	r=-0.336;		r=0.158;	r=-0.395;
HDL	p=0.094	p=0.496	p=0.579	p=0.381	**p=0.022**	p=0.147	/	p=0.507	p=0.085
	r=-0.261;	r=0.086;	r=0.189;	r=0.152;	r=0.957;	r=0.573;	r=0.158;		r=-0.377;
LDL	p=0.266	p=0.718	p=0.426	p=0.522	**p<0.001**	**p=0.008**	p=0.507	/	p=0.063
	r=0.193;	r=-0.215;	r=-0.185;	r=-0.063;	r=-0.527;	r=-0.297;	r=-0.395;	r=-0.377;	
CRP	p=0.414	p=0.362	p=0.434	p=0.793	p=0.057	p=0.204	p=0.085	p=0.063	/

GLU, blood glucose; BUN, blood urea nitrogen; Cr, creatinine; UA, uric acid; TC, total cholesterol; TG, triglyceride; HDLc, high-density lipoprotein-cholesterol; LDLc, low-density lipoprotein-cholesterol; CRP, C-reactive protein.

Supplementary Table S6. subgroup analysis of VD in the uveitis and control groups

	Idiopathic panuveitis	VKH disease	Behçet's disease	Control	p-value*	p-value**	p-value***	p-value#	p-value##
Whole VD SCP (%)	46.54 ± 4.25	46.04 ± 6.09	45.21 ± 3.68	48.97 ± 3.88	**0.007**	**0.006**	**0.003**	0.728	0.372
Parafovea VD SCP (%)	46.78 ± 4.76	47.08 ± 5.98	46.31 ± 5.15	50.62 ± 5.29	**0.001**	**0.004**	**0.011**	0.837	0.791
Whole VD DCP (%)	45.75 ± 5.91	45.54 ± 4.98	45.58 ± 4.61	48.25 ± 6.60	**0.046**	**0.047**	**0.041**	0.887	0.932
Parafovea VD DCP (%)	51.43 ± 6.35	51.67 ± 5.62	52.80 ± 4.51	54.01 ± 4.62	**0.023**	**0.029**	**0.036**	0.881	0.559
Whole VD outer retina (%)	15.03 ± 4.12	13.96 ± 2.76	15.84 ± 4.77	14.69 ± 3.14	0.579	0.369	0.266	0.268	0.604
Whole VD Choriocapillaris (%)	23.44 ± 1.75	23.46 ± 1.01	23.12± 0.91	24.21 ± 1.18	**0.014**	**0.011**	**0.004**	0.965	0.561
FAZ (mm^2)	0.29 ± 0.09	0.31 ± 0.08	0.32 ± 0.07	0.33 ± 0.13	0.186	0.562	0.933	0.387	0.285
FD-300 Area Density (%)	46.24 ± 7.11	46.75 ± 6.81	43.267± 10.33	54.03 ± 5.70	**<0.001**	**<0.001**	**<0.001**	0.435	0.125
FD-300 Length Density (%)	9.98 ± 2.78	10.17 ± 2.21	9.17 ± 3.65	11.54 ± 2.29	**0.006**	**0.009**	**0.005**	0.782	0.462
Optic disk VD (%)	54.25 ± 5.68	51.54 ± 5.38	53.97 ± 4.79	56.35 ± 2.43	**0.019**	**<0.001**	**0.018**	0.078	0.889

The data were presented as mean ± SD. SD, standard deviation; VD, vascular density; SCP, superficial capillary plexus; DCP, deep capillary plexus; FAZ, foveal avascular zone; FD300, Foveal density 300 μm. *Difference between Idiopathic panuveitis and normal controls, **difference between VKH disease and normal controls, ***difference between Behçet's disease and normal controls. #Difference between Idiopathic panuveitis and Behçet's disease, ## difference between VKH disease and Behçet's disease

Supplementary Table S7. Correlation between biological parameters and vascular density in the uveitis

	GLU	BUN	Cr	UA	TC	TG	HDLc	LDLc	CRP
Whole VD SCP (%)	r=0.118; p=0.534	r=-0.193; p=0.299	r=0.027; p=0.887	r=-0.413; **p=0.021**	r=-0.246; p=0.207	r=-0.105; p=0.597	r=-0.489; **p=0.008**	r=0.051; p=0.693	r=0.210; p=0.561
Parafovea VD SCP (%)	r=0.107; p=0.575	r=-0.071; p=0.706	r=0.161; p=0.958	r=-0.253; p=0.169	r=-0.132; p=0.502	r=0.032; p=0.873	r=-0.480; **p=0.026**	r=0.047; p=0.713	r=0.082; p=0.823
Whole VD DCP (%)	r=-0.422; **p=0.020**	r=-0.387; **p=0.031**	r=-0.013; p=0.467	r=0.183; p=0.325	r=0.111; p=0.574	r=0.219; p=0.262	r=0.170; p=0.387	r=0.576; **p=0.032**	r=-0.201; p=0.579
Parafovea VD DCP (%)	r=-0.379; **p=0.039**	r=-0.407; **p=0.023**	r=-0.266; p=0.156	r=0.130; p=0.485	r=-0.005; p=0.979	r=0.167; p=0.396	r=0.207; p=0.291	r=0.267; **p=0.034**	r=-0.266; p=0.458
Whole VD outer retina (%)	r=0.007; p=0.969	r=0.314; p=0.086	r=0.098; p=0.606	r=0.068; p=0.716	r=0.008; p=0.968	r=0.088; p=0.655	r=-0.046; p=0.815	r=0.221; p=0.081	r=-0.267; p=0.455
Whole VD Choriocapillaris (%)	r=-0.041; p=0.830	r=-0.484; p=0.006	r=-0.190; p=0.315	r=0.118; p=0.527	r=-0.139; p=0.479	r=0.103; p=0.600	r=0.154; p=0.433	r=0.135; p=0.292	r=-0.285; p=0.425
FAZ (mm^2)	r=-0.290; p=0.121	r=-0.263; p=0.152	r=-0.213; p=0.259	r=0.115; p=0.538	r=0.163; p=0.406	r=0.079; p=0.539	r=0.237; p=0.224	r=0.079; p=0.539	r=0.432; p=0.212
FD-300 Area Density (%)	r=-0.067; p=0.727	r=0.133; p=0.477	r=0.034; p=0.859	r=0.028; p=0.881	r=0.372; p=0.051	r=-0.004; p=0.986	r=0.141; p=0.476	r=-0.061; p=0.638	r=-0.080; p=0.826
FD-300 Length Density (%)	r=-0.135; p=0.477	r=0.139; p=0.455	r=0.083; p=0.661	r=0.019; p=0.921	r=0.260; p=0.181	r=0.020; p=0.920	r=0.119; p=0.547	r=0.021; p=0.873	r=-0.124; p=0.733
Optic disk VD (%)	r=-0.295; p=0.114	r=-0.494; **p=0.005**	r=-0.387; **p=0.035**	r=-0.201; p=0.278	r=-0.212; p=0.279	r=-0.024; p=0.905	r=-0.151; p=0.443	r=-0.039; p=0.764	r=0.207; p=0.567

GLU, blood glucose; BUN, blood urea nitrogen; Cr, creatinine; UA, uric acid; TC, total cholesterol; TG, triglyceride; HDLc, high-density lipoprotein-cholesterol; LDLc, low-density lipoprotein-cholesterol; CRP, C-reactive protein. VD, vascular density; SCP, superficial capillary plexus; DCP, deep capillary plexus; FAZ, foveal avascular zone; FD300, Foveal density 300 μm.