Evaluating the impact of anti-CGRP monoclonal antibodies on retinal features in migraine patients: a retrospective optical coherence tomography study.

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Background

Migraine is a disabling neurovascular disorder characterized by recurrent attacks that often involve extracranial and visual pathways. Previous studies investigating retinal vasculature in migraine have produced conflicting results. Understanding ocular changes may help identify early biomarkers of migraine-realated neurovascular dysfunction.

Methods

A mixed case-control and longitudinal study was conducted from January 2021 to December 2023. The sample included 32 eyes from 16 migraine patients treated with anti-CGRP mAbs and 20 eyes from 10 healthy controls (HCs). SD-OCT was used to assess central retinal thickness, macular structure, and peripapillary retinal nerve fiber layer (pRNFL) thickness; OCT-A measured retinal vessel density. Measurements were obtained at T0 and T1 as part of routine clinical care.

	Single migraine patient data																Overall data	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Mean (±SD)	*n* (%)
Age (years)	39	40	43	44	59	42	63	48	55	51	54	30	38	50	37	42	46.1 (8.6)	
Sex	F	F	F	F	F	F	F	F	F	F	M	F	F	F	M	F		
Migraine duration (years)	15	25	10	20	22	20	30	25	45	20	20	5	20	30	20	30	22.3 (9.1)	
Type of migraine	MA	MwA	MwA	MwA	MwA	MwA	MwA	MwA	MwA	MwA	MwA	MwA	MA	MwA	MA	MwA		
BMI (kg/m²)	19.5	20.8	23.1	21.8	24	21	22	24.8	24.3	24.5	21.7	20.8	20.4	24.7	24.2	24.4	22.3 (1.5)	
Concomitant treatments	N	N	Y	N	N	N	N	Y	N	Y	N	N	N	N	N	Y		4 (25)
Comorbidities	N	Y[a]	N	N	N	N	N	Y[a]	N	Y[a]	Y[b]	N	N	N	N	Y[c]		5 (31.2)
No. of previous preventive therapies	5	4	4	5	3	4	6	8	6	6	4	4	4	4	3	6	4.7 (1.3)	
Anti-CGRP mAb	Fr	E	Fr	Fr	E	E	E	G	Fr	Fr	G	Fr	Fr	G	Fr	G		
Baseline (T0)																		
MMDs	16	14	20	12	10	13	20	20	20	16	16	10	12	18	12	20	15.6 (3.8)	
MHDs	3	1	5	1	1	1	5	5	5	1	2	0	0	3	1	4	2.3 (1.9)	
MPNs	14	14	40	15	8	12	16	18	25	20	16	10	12	18	10	24	17 (7.8)	
MIDAS score	210	37	44	26	30	50	40	150	42	80	50	36	55	60	40	100	65.6 (49.6)	
HIT-6 score	67	69	67	66	63	70	70	71	78	74	68	62	66	69	66	72	68.6 (3.9)	
6-Month follow-up (T1)																		
MMDs	6	5	5	4	4	5	6	7	8	7	7	5	4	5	2	6	5.4 (1.5)	
MHDs	1	0	1	0	0	0	2	2	2	0	0	0	0	1	0	1	0.6 (0.8)	
MPNs	6	3	3	2	4	5	6	7	7	7	7	5	4	5	1	5	4.8 (1.9)	
MIDAS score	45	11	10	6	7	11	8	35	10	18	12	9	12	10	5	10	13.7 (10.8)	
HIT-6 score	58	60	60	60	58	60	60	60	66	60	58	56	58	60	50	54	58.6 (3.4)	

[a]Psychiatric comorbidities.
[b]Gastrointestinal comorbidities.
[c]Endocrine comorbidities.
CGRP, calcitonin gene-related peptide; E, erenumab; F, female; Fr, fremanezumab; G, galcanezumab; HIT-6, Headache Impact Test-6; M, male; MA, migraine with aura; mAb, monoclonal antibody; MHDs, monthly headache days; MIDAS, Migraine Disability Assessment; MMDs, monthly migraine days; MPNs, number of painkillers used per month; MwA, migraine without aura; N, no; NA, not available; SD, standard deviation; T0, baseline; T1, evaluation performed at 6 months; Y, yes.

SD-OCT parameter	Mean (±SD)				*p* Value			
	HCs T0	HCs T1	Migraineurs T0	Migraineurs T1	HCs vs Migraineurs T0	HCs T0 vs T1	HCs vs Migraineurs T1	Migraineurs T0 vs T1
RNFL								
Total	100.2 (10.2)	98.1 (16.7)	96.2 (9)	97 (10.2)	0.15	0.64	0.27	0.09
Temporal	68.9 (4.7)	69.4 (7.3)	74.2 (10.3)	74.5 (11.3)	0.03*	0.81	0.04*	0.71
Temporal superior	130.1 (17.5)	140.6 (16)	130.2 (24.9)	131.9 (26.2)	0.99	0.06	0.78	0.02*
Temporal inferior	146.6 (13.8)	147.9 (21.2)	146.2 (19.2)	145.7 (18.1)	0.93	0.8	0.84	0.69
Nasal	90.2 (14.4)	91.7 (21)	79.9 (12.8)	80.3 (14.1)	0.01*	0.8	0.02*	0.67
Nasal superior	112.9 (21.8)	112.9 (29.7)	103.4 (19.1)	104.7 (19.8)	0.10	1	0.16	0.08
Nasal inferior	110.1 (24.2)	110.1 (34.3)	102.1 (19.8)	103.6 (24.1)	0.20	1	0.35	0.46
GCL								
Superior	53.2 (5.3)	52.2 (7)	52.7 (3.9)	52.5 (4.1)	0.68	0.6	0.58	0.62
Superior Nasal	51.2 (5)	53.7 (6.3)	52.5 (4)	52.8 (4.5)	0.29	0.17	0.22	0.25
Superior temporal	50.8 (5)	50.3 (6)	49.1 (5.1)	48.7 (5.1)	0.24	0.77	0.15	0.45
Inferior	53.7 (5.3)	53.7 (8)	52.2 (5.1)	52.4 (4.6)	0.32	1	0.36	0.75
Inferior nasal	52.4 (4.1)	52 (4.8)	52.6 (4.7)	53.1 (4.7)	0.86	0.77	0.56	0.10
Inferior temporal	52.5 (4.5)	51.6 (6)	51.4 (4.8)	51.1 (5.4)	0.43	0.42	0.33	0.21
Parafoveal thickness	334.6 (15)	337.6 (22.4)	337.1 (14.1)	335 (18.6)	0.53	0.62	0.93	0.16
Foveal thickness	255 (20)	250 (31)	256.1 (20)	258.8 (20.5)	0.78	0.63	0.94	0.08
Disc area mm²	1.85 (0.43)	1.78 (0.62)	1.88 (0.42)	1.9 (0.43)	0.95	0.69	0.76	0.91
RIM area mm²	1.59 (0.36)	1.7 (0.6)	1.53 (0.32)	1.62 (0.32)	0.55	0.71	0.76	0.12

*Statistically significant results.
GCL, ganglion cell layer; HCs, healthy controls; RIM area, total area of the neuroretinal rim; RNFL, retinal nerve fiber layers; SD, standard deviation; SD-OCT, spectral-domain optical coherence tomography; T0, baseline; T1, evaluation performed at 6 months.

Results

At baseline, migraine patients showed increased temporal and decreased nasal RNFL thickness compared with HCs, with no differences in retinal circulation. After six months of anti-CGRP therapy, disease disability significantly improved, temporal RNFL thickness remained sustained in the superior-temporal sector, and vessel density increased in the nasal perifoveal, inferior-temporal, and hemi-inferior subregions of the superficial capillary plexus and radial peripapillary capillary.The repeated-measures ANOVA, using the reduction in migraine days as a covariate, showed a significant effect only on the temporal superior retinal nerve fiber layer (RNFL) thickness after 6 months of monoclonal antibody (mAb) therapy in the migraine group. No significant changes were found in OCT-A parameters between baseline (T0) and 6 months (T1), despite the improvement in migraine days.

Conclusions

Specific retinal structural changes appear to precede vascular dysfunction in migraine and can be detected using combined SD-OCT and OCT-A imaging. Short-term anti-CGRP mAb therapy may exert neuroprotective effects on the retinal nerve fiber layer, potentially preventing irreversible ocular damage.

Table 3. Comparison of interictal retinal vascular parameters across groups by using statistical analysis.

OCT-A parameters	Mean (±SD)				*p* Value			
	HCs T0	HCs T1	Migraineurs T0	Migraineurs T1	HCs vs migraineurs T0	HCs, T0 vs T1	HCs vs migraineurs T1	Migraineurs, T0 vs T1
RPC VD								
Whole image	49.7 (2.9)	49.6 (4.1)	49.5 (2.8)	49.3 (2.5)	0.72	0.89	0.80	0.62
Inside disc	54.9 (2.4)	54 (2.6)	54.1 (4.1)	53.8 (3.5)	0.50	0.27	0.32	0.76
Peripapillary total	51.2 (3.4)	51.4 (4.27)	51.1 (2.9)	51.2 (3.2)	0.73	0.88	0.84	0.32
Peripapillary superior hemi	51.8 (3.9)	50.8 (5.8)	51.3 (3.5)	51.2 (3.9)	0.48	0.52	0.55	0.70
Peripapillary Superior nasal	47.9 (4.4)	47.6 (6)	48.2 (5.5)	47.1 (5.3)	0.85	0.89	0.71	0.92
Peripapillary Superior temporal	55.2 (4.2)	54.6 (6.1)	55.6 (4.8)	55.3 (4.8)	0.93	0.7	0.86	0.39
Peripapillary Inferior hemi	51 (3.4)	52.2 (3.5)	50.8 (3.2)	51.4 (3)	0.72	0.27	0.43	0.03*
Peripapillary Inferior nasal	48.4 (4.9)	47.7 (7.6)	48.4 (5)	49.3 (4.7)	0.80	0.71	0.25	0.10
Peripapillary Inferior temporal	56.8 (3)	57.9 (4.2)	57.4 (4.3)	58.3 (4.5)	0.65	0.35	0.13	0.02*
Peripapillary Nasal superior	49.5 (4)	49.7 (5)	48.7 (3.5)	48.4 (4.2)	0.29	0.88	0.27	0.76
Peripapillary Nasal inferior	48.7 (4.1)	47.3 (6.4)	46.7 (4.8)	47.1 (4.1)	0.07	0.39	0.29	0.23
Peripapillary Temporal superior	54 (3.7)	54 (5.4)	55.3 (3)	55.6 (3.1)	0.24	1	0.08	0.42
Peripapillary temporal inferior	52.1 (4.7)	54.2 (1)	52.2 (4.4)	52.7 (3.6)	0.79	0.36	0.69	0.20
Superficial whole image VD	52.8 (1.7)	53.4 (2.5)	53 (2)	53.6 (1.8)	0.94	0.32	0.36	0.16
Superficial foveal VD	23.5 (6.9)	24.2 (8.8)	21.3 (5.5)	21 (5.9)	0.09	0.78	0.06	0.15
Superficial parafoveal VD								
Total	55.5 (2)	54.9 (2.4)	55.9 (1.9)	56.2 (1.5)	0.47	0.41	0.16	0.40
Superior	56.4 (2.7)	56.9 (3.9)	56.4 (2.4)	56.6 (2.3)	0.79	0.61	0.71	0.85
Superior hemi	55.5 (2.3)	55.8 (3.3)	55.8 (1.8)	56.2 (1.71)	0.51	0.7	0.26	0.36
Inferior	56.4 (2.7)	57.4 (4)	56.3 (2.3)	57 (1.9)	0.24	0.32	0.80	0.14
Inferior hemi	55.6 (2)	55.6 (2.8)	56 (2.2)	56.2 (1.6)	0.49	1	0.23	0.63
Nasal	54.9 (1.8)	55.3 (2.2)	53.5 (10)	55.7 (1.5)	0.53	0.48	0.09	0.19
Temporal	54.4 (2)	53.3 (3)	55.5 (2.2)	55.5 (2)	0.10	0.21	0.06	0.66
Superficial perifoveal VD								
Total	53.3 (1.9)	52.7 (3.4)	53.7 (2)	54.3 (1.7)	0.91	0.51	0.25	0.09
Superior	53.9 (2)	53.7 (3)	53.8 (2.7)	54.7 (1.9)	0.57	0.81	0.54	0.07
Superior hemi	53.3 (1.8)	53 (2.7)	53.7 (1.8)	54.2 (1.7)	0.89	0.62	0.34	0.15
Inferior	53.8 (2.6)	54.8 (3.4)	53.8 (2.8)	54.6 (1.9)	0.60	0.29	0.64	0.06
Inferior hemi	53.2 (2.2)	53.6 (2.8)	53.7 (2.5)	54.4 (1.8)	0.93	0.58	0.21	0.08
Nasal	56.8 (1.8)	57.3 (2.7)	57.1 (2.1)	58 (2)	0.84	0.46	0.08	0.02*
Temporal	48.7 (2.2)	48.5 (2.7)	49.7 (2.3)	49.7 (2)	0.30	0.78	0.19	0.78

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