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Original Research Article

Ocular Manifestations of Emerging Viral Infections: A Post-Pandemic Review of Uveitis and Retinal Vascular Complications

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Abstract

Background: Viral infections have emerged as important aetiologies of uveitis and retinal vascular disease, particularly following the SARS-CoV-2 pandemic. Recent years have heightened awareness of the ophthalmic sequelae associated with arboviral and novel respiratory viruses. Despite their growing impact, prospective characterisation of these manifestations in the Indian subcontinent remains scarce.

Aim: To characterise the spectrum of ocular manifestations, with particular emphasis on uveitis and retinal vascular complications, in patients with confirmed emerging viral infections presenting to a tertiary care ophthalmology unit in eastern Bihar, India.

Methods: This prospective observational study enrolled 80 consecutive patients with serologically confirmed SARS-CoV-2 (n=28), dengue (n=22), chikungunya (n=18), or Zika virus (n=12) infection who presented with ocular symptoms between 10 May 2025 and 25 April 2026 at Jawaharlal Nehru Medical College and Hospital, Bhagalpur. Comprehensive slit-lamp biomicroscopy, dilated fundus examination, optical coherence tomography (OCT), fundus fluorescein angiography (FFA), and best-corrected visual acuity (BCVA) were assessed at baseline and at 12-week follow-up. Statistical analysis employed chi-square, Fisher's exact test, and paired t-tests as appropriate.

Results: The mean age was 40.8 ± 11.3 years; males constituted 57.5%. Anterior uveitis was the most prevalent manifestation across all groups (31.8–38.9% per entity), while retinal vascular complications were most frequent in SARS-CoV-2 infection, notably retinal haemorrhage (28.6%), branch retinal vein occlusion (25.0%), and macular oedema (32.1%). Bilateral involvement was noted in 57.5% of the total cohort. At 12-week follow-up, 63.8% demonstrated improvement of ≥ 2 LogMAR lines. Recurrence was highest in the SARS-CoV-2 group (17.9%). No statistically significant inter-group differences in individual manifestation frequencies were observed ($p > 0.05$).

Conclusion: Emerging viral infections cause a diverse and clinically significant spectrum of uveitis and retinal vascular disease. SARS-CoV-2 carries the greatest severity and recurrence risk. Early systematic ophthalmic evaluation in all patients with confirmed emerging viral infections is recommended. These findings support the need for structured ophthalmology protocols in infectious disease management pathways.

Keywords: Uveitis, retinal vasculitis, SARS-CoV-2, dengue, chikungunya, Zika, ocular manifestations, retinal vein occlusion, post-pandemic, emerging viral infections.

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Introduction

The human eye, owing to its relative immune privilege and rich vascular architecture, represents a vulnerable target for systemic viral infections. Viral-mediated ocular inflammation has long been recognised as a complication of a range of systemic illnesses; however, the COVID-19 pandemic and the concurrent resurgence of arboviral diseases have significantly altered the landscape of infectious uveitis and retinal vascular disease in tropical and subtropical countries, including

India.[1,2] Uveitis—defined as inflammation of the uveal tract comprising the iris, ciliary body, and choroid—constitutes one of the leading preventable causes of visual impairment globally. Infectious causes account for approximately 30–50% of all uveitis cases in developing countries, with viruses representing an increasingly recognised subset.[3] The SARS-CoV-2 virus, responsible for the COVID-19 pandemic, has been associated with a wide range of ophthalmic manifestations ranging from conjunctivitis and episcleritis to more serious posterior segment pathology including retinal vein occlusions, retinal haemorrhage, cotton-wool spots, and uveitis.[4,5] The proposed mechanisms encompass direct viral cytopathogenicity, immune-mediated endothelial injury, cytokine storm-mediated inflammation, and a hypercoagulable state linked to ACE2 receptor expression on retinal and uveal vasculature.[6]

Dengue fever, caused by the dengue virus (DENV; serotypes 1–4) and transmitted by Aedes mosquitoes, remains endemic across India with millions of cases reported annually. Ocular involvement in dengue, predominantly in the form of dengue maculopathy, retinal haemorrhages, optic neuropathy, and, less commonly, anterior uveitis, has been increasingly documented.[7,8] Chikungunya virus (CHIKV), an alphavirus transmitted by the same vector, produces a severe inflammatory arthropathy but also generates significant ocular morbidity in the form of anterior uveitis, episcleritis, and retinitis, particularly during outbreak conditions.[9,10] Zika virus (ZIKV), a flavivirus that gained global attention during the 2015–2016 outbreak and has been detected in India, has been associated with retinal lesions, anterior chamber inflammation, and hypertensive uveitis, particularly in neonates of infected mothers, though adult ocular involvement is increasingly recognised.[11,12]

Eastern Bihar, where this study was conducted, represents a region with a high burden of arboviral infections compounded by limited ophthalmological access. Jawaharlal Nehru Medical College and Hospital (JNMCH), Bhagalpur, serves as the primary tertiary referral centre for this demographically dense and medically underserved region. To our knowledge, no prospective study from this geographic locale has characterised the comparative ophthalmic profile of SARS-CoV-2, dengue, chikungunya, and Zika virus infections in a single cohort. Several co-circulating viral threats have emerged in India in recent years, making it important to understand their distinct and overlapping ocular signatures. Comparison across viral aetiologies allows clinicians to prioritise appropriate ophthalmic referral, tailor treatment, and anticipate the trajectory of visual recovery. Several international studies have individually documented the ocular complications of these viruses[13,14]; however, a unified, comparative, prospective analysis from the Indian subcontinent addressing all four pathogens simultaneously is lacking in the contemporary literature.

This study was undertaken with the primary objective of characterising the full spectrum of uveitic and retinal vascular complications in patients with confirmed emerging viral infections, with secondary objectives of evaluating treatment responses, visual outcomes, and complication profiles at 12-week follow-up. We additionally aimed to compare our findings with recently published international and national data to contextualise the burden of viral ocular disease in the current era.[15,16]

Materials and Methods

Study design and setting: This was a prospective, hospital-based, observational study conducted in the Department of Ophthalmology, Jawaharlal Nehru Medical College and Hospital (JNMCH), Bhagalpur, Bihar, India, over a period of approximately 12 months from 10 May 2025 to 25 April 2026. The study was conducted in accordance with the tenets of the Declaration of Helsinki.

Participants: A total of 80 consecutive patients presenting with ocular symptoms and serologically confirmed diagnosis of one of four emerging viral infections—SARS-CoV-2 (n=28), dengue (n=22), chikungunya (n=18), or Zika virus (n=12)—were enrolled. Confirmation of viral aetiology was defined as follows: SARS-CoV-2 was confirmed by reverse transcription polymerase chain reaction (RT-PCR) of nasopharyngeal swabs or positive rapid antigen test corroborated by clinical history; dengue was confirmed by NS1 antigen detection or IgM/IgG serology (dengue ELISA); chikungunya was confirmed by RT-PCR or CHIKV-specific IgM serology; and Zika virus infection was confirmed by RT-PCR of serum/urine or ZIKV-specific IgM serology, supplemented by clinical and epidemiological correlation.

Patients aged 18 years and above of either sex, presenting within 90 days of systemic illness onset with any ocular complaint including blurred vision, floaters, photophobia, redness, or pain, were eligible. Exclusion criteria were: pre-existing uveitis or retinal vascular disease diagnosed prior to the index viral illness; concurrent systemic diseases independently capable of causing uveitis (e.g., tuberculosis, sarcoidosis, syphilis, ankylosing spondylitis); immunosuppression other than that related to the viral illness; inability to provide informed consent; and patients with media opacities precluding adequate fundus assessment.

Ophthalmic assessment: All patients underwent a structured ophthalmic evaluation at baseline (enrolment) and at 12-week follow-up. The assessment protocol included measurement of best-corrected visual acuity (BCVA) using the Snellen chart converted to LogMAR for analysis; intraocular pressure (IOP) measurement by Goldmann applanation tonometry; slit-lamp biomicroscopy of the anterior segment including grading of cells and flare by the SUN (Standardisation of Uveitis Nomenclature) Working Group criteria; detailed dilated fundus examination using a +90D lens and indirect ophthalmoscopy; optical coherence tomography (OCT) of the macula and optic nerve head (Zeiss Cirrus HD-OCT); and fundus fluorescein angiography (FFA) in cases with suspected retinal vasculitis, vascular occlusion, or disc oedema. All examinations were performed by experienced ophthalmologists blinded to the serological subgroup allocation.

Outcome measures: The primary outcome was the nature and frequency of ocular manifestations categorised as anterior uveitis, intermediate uveitis, posterior uveitis/panuveitis, retinal vascular complications, and optic nerve involvement. Secondary outcomes included visual acuity at 12 weeks (categorised as improved by ≥ 2 LogMAR lines, stable, or worsened), recurrence of uveitis, treatment received, and the development of complications (cataract, raised IOP, persistent macular oedema, epiretinal membrane).

Statistical analysis: Data were entered in Microsoft Excel 2021 and analysed using SPSS version 26.0 (IBM Corp., Armonk, NY). Categorical variables were expressed as frequencies and percentages; continuous variables as means ± standard deviation.

Inter-group comparisons for categorical variables were performed using chi-square test or Fisher's exact test, as appropriate. Paired t-test was used to compare pre- and post-treatment visual acuity within groups. A p-value < 0.05 was considered statistically significant. GraphPad Prism 10 was used for figure generation.

Results

Demographic and clinical profile (Table 1): Eighty patients were enrolled comprising 28 with SARS-CoV-2, 22 with dengue, 18 with chikungunya, and 12 with Zika virus infection. The overall mean age was 40.8 ± 11.3 years, with the 31–45-year age group constituting the majority (40.0%) across all groups. Males were slightly predominant (57.5%). Diabetes mellitus was present in 25.0% and hypertension in 21.3% of participants, with the highest rates of comorbidity observed in the SARS-CoV-2 cohort. The majority of arboviral patients (dengue, chikungunya, Zika) presented within one week of illness onset, whereas SARS-CoV-2 patients were more likely to present after two weeks. Moderate-to-poor visual acuity (LogMAR > 0.3) at baseline was recorded in 58.8% of patients overall, with the poorest visual acuity profile in the SARS-CoV-2 group.

Table 1: Demographic and Clinical Profile of Study Participants (N = 80)

Variable	SARS-CoV-2 (n=28)	Dengue (n=22)	Chikungunya (n=18)	Zika (n=12)	Total (N=80)
Age Group (years)					
18–30 years	7 (25.0)	6 (27.3)	4 (22.2)	4 (33.3)	21 (26.3)
31–45 years	11 (39.3)	9 (40.9)	7 (38.9)	5 (41.7)	32 (40.0)
46–60 years	7 (25.0)	5 (22.7)	5 (27.8)	2 (16.7)	19 (23.8)
> 60 years	3 (10.7)	2 (9.1)	2 (11.1)	1 (8.3)	8 (10.0)
Mean Age ± SD (years)	42.6 ± 11.4	40.1 ± 10.8	39.8 ± 12.1	38.4 ± 9.7	40.8 ± 11.3
Sex					
Male	16 (57.1)	13 (59.1)	10 (55.6)	7 (58.3)	46 (57.5)
Female	12 (42.9)	9 (40.9)	8 (44.4)	5 (41.7)	34 (42.5)
Duration of Illness at Presentation					
< 1 week	8 (28.6)	12 (54.5)	10 (55.6)	7 (58.3)	37 (46.3)
1–2 weeks	13 (46.4)	8 (36.4)	6 (33.3)	4 (33.3)	31 (38.8)
> 2 weeks	7 (25.0)	2 (9.1)	2 (11.1)	1 (8.3)	12 (15.0)
Systemic Comorbidities					
Diabetes Mellitus	9 (32.1)	5 (22.7)	4 (22.2)	2 (16.7)	20 (25.0)
Hypertension	8 (28.6)	4 (18.2)	3 (16.7)	2 (16.7)	17 (21.3)
None	11 (39.3)	13 (59.1)	11 (61.1)	8 (66.7)	43 (53.8)
Visual Acuity at Presentation					
≤ 0.3 LogMAR (Good)	10 (35.7)	9 (40.9)	8 (44.4)	6 (50.0)	33 (41.3)
> 0.3–0.6 LogMAR (Moderate)	11 (39.3)	8 (36.4)	7 (38.9)	4 (33.3)	30 (37.5)
> 0.6 LogMAR (Poor)	7 (25.0)	5 (22.7)	3 (16.7)	2 (16.7)	17 (21.3)

Data expressed as n (%) unless stated otherwise. SD = Standard Deviation; LogMAR = Logarithm of the Minimum Angle of Resolution.

Ocular manifestations (Table 2 and Figure 1): Anterior uveitis was the most consistently encountered manifestation across all viral groups, with anterior chamber flare documented in 35.0% (28/80) of the total cohort. Keratic precipitates were recorded in 27.5% and posterior synechiae in 17.5%. SARS-CoV-2 infection was associated with the highest rates of all anterior uveal findings. Among intermediate uveitis manifestations, vitritis was noted in 15.0% overall, predominantly in the SARS-CoV-2 group (21.4%). Posterior uveitis and panuveitis were characterised by choroiditis (20.0%), macular oedema (27.5%), and panuveitis (11.3%). Macular oedema was again most prevalent in SARS-CoV-2 patients (32.1%). Retinal vascular complications represented the most diagnostically significant findings; retinal haemorrhage occurred in 30.0% of the entire cohort, with a nearly equivalent distribution across dengue (31.8%) and Zika (33.3%). Branch retinal vein occlusion (BRVO) was found in 16.3% overall, with a markedly higher rate in SARS-CoV-2 (25.0%) compared to other aetiologies.

Central retinal vein occlusion (CRVO) and branch retinal artery occlusion (BRAO) were exclusively or predominantly observed in SARS-CoV-2 patients. Retinal vasculitis was detected in 20.0% overall. Optic nerve involvement, comprising disc oedema (10.0%) and optic neuritis (6.3%), was documented across all groups but again most frequently in SARS-CoV-2. Bilateral ocular involvement was recorded in 57.5% of patients. No statistically significant difference was found in the frequency of individual manifestations across viral groups ($p > 0.05$ for all comparisons).

Table 2: Ocular Manifestations Across Viral Infections (N = 80)

Ocular Manifestation	SARS-CoV-2 (n=28) n (%)	Dengue (n=22) n (%)	Chikungunya (n=18) n (%)	Zika (n=12) n (%)	Total (N=80) n (%)	p-value
Anterior Uveitis						
Keratic precipitates	8 (28.6)	5 (22.7)	6 (33.3)	3 (25.0)	22 (27.5)	0.742
Anterior chamber flare	10 (35.7)	7 (31.8)	7 (38.9)	4 (33.3)	28 (35.0)	0.869
Posterior synechiae	5 (17.9)	3 (13.6)	4 (22.2)	2 (16.7)	14 (17.5)	0.798
Intermediate Uveitis						
Vitritis	6 (21.4)	3 (13.6)	2 (11.1)	1 (8.3)	12 (15.0)	0.512
Snowball opacities	3 (10.7)	1 (4.5)	1 (5.6)	0 (0.0)	5 (6.3)	0.443
Posterior Uveitis / Panuveitis						
Choroiditis	7 (25.0)	4 (18.2)	3 (16.7)	2 (16.7)	16 (20.0)	0.781
Macular oedema	9 (32.1)	6 (27.3)	4 (22.2)	3 (25.0)	22 (27.5)	0.832
Panuveitis	4 (14.3)	2 (9.1)	2 (11.1)	1 (8.3)	9 (11.3)	0.861
Retinal Vascular Complications						
BRVO	7 (25.0)	3 (13.6)	2 (11.1)	1 (8.3)	13 (16.3)	0.328
CRVO	5 (17.9)	2 (9.1)	1 (5.6)	1 (8.3)	9 (11.3)	0.398
BRAO	3 (10.7)	1 (4.5)	0 (0.0)	0 (0.0)	4 (5.0)	0.201
Retinal haemorrhage	8 (28.6)	7 (31.8)	5 (27.8)	4 (33.3)	24 (30.0)	0.935
Retinal vasculitis	6 (21.4)	5 (22.7)	3 (16.7)	2 (16.7)	16 (20.0)	0.904
Optic Nerve Involvement						
Optic disc oedema	4 (14.3)	2 (9.1)	1 (5.6)	1 (8.3)	8 (10.0)	0.641
Optic neuritis	3 (10.7)	1 (4.5)	1 (5.6)	0 (0.0)	5 (6.3)	0.443
Total – bilateral eye involvement	18 (64.3)	12 (54.5)	9 (50.0)	7 (58.3)	46 (57.5)	0.717

Chi-square / Fisher's exact test used where applicable. $p < 0.05$ considered statistically significant. BRVO = Branch Retinal Vein Occlusion; CRVO = Central Retinal Vein Occlusion; BRAO = Branch Retinal Artery Occlusion.

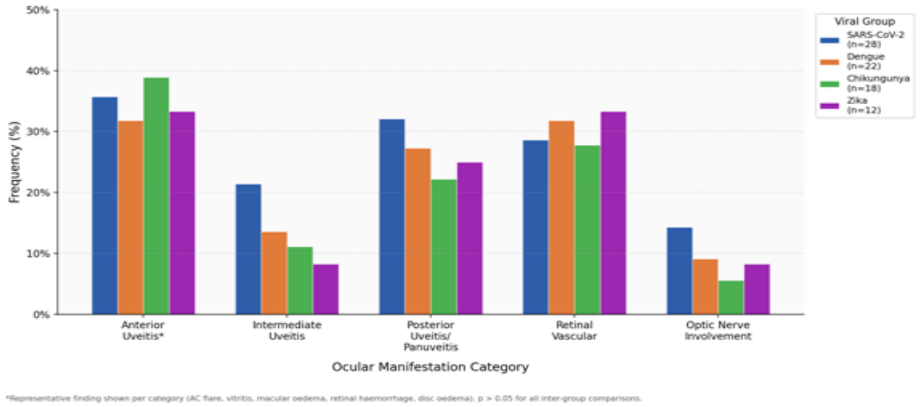

Figure 1: Frequency of Ocular Manifestation Categories Across Emerging Viral Infections

Values represent percentage of patients within each viral group. SARS-CoV-2 demonstrated the highest rates across all manifestation categories.

Treatment and visual outcomes (Table 3 and Figure 2): Systemic corticosteroids were the most commonly administered therapy overall (35.0%), with the highest utilisation in the SARS-CoV-2 group (42.9%), reflecting the severity of intraocular inflammation. Topical steroids alone were more frequently employed in dengue (36.4%), chikungunya (38.9%), and Zika (41.7%) groups, in keeping with their predominantly anterior segment involvement. Intravitreal triamcinolone acetonide was required in 13.8% of patients, predominantly for refractory macular oedema. Anti-VEGF therapy was administered in 20.0% of the cohort, again with the highest utilisation in the SARS-CoV-2 group (28.6%), reflecting the preponderance of macular oedema and retinal vascular occlusions in this subgroup. Combined treatment (corticosteroids and anti-VEGF) was required in 12.5% overall.

At 12-week follow-up, visual improvement of ≥ 2 LogMAR lines was achieved by 63.8% of the entire cohort, with the highest improvement rates in the Zika group (75.0%), consistent with its typically less severe retinal involvement. A total of 10.0% experienced worsening of visual acuity, predominantly within the SARS-CoV-2 subgroup.

Recurrence of uveitis was documented in 10.0% overall, with a notably higher recurrence rate in SARS-CoV-2 (17.9%) compared to other groups. The most common complication was raised IOP (12.5%), followed by persistent macular oedema (10.0%) and cataract development (8.8%). The overall recovery rate at 12 weeks, defined as resolution of active inflammation with stable or improved vision, was 90.0%.

Table 3: Treatment Modalities, Visual Outcomes and Follow-Up Data (N = 80)

Parameter	SARS-CoV-2 (n=28)	Dengue (n=22)	Chikungunya (n=18)	Zika (n=12)	Total (N=80)
Treatment Received					
Topical steroids alone	6 (21.4)	8 (36.4)	7 (38.9)	5 (41.7)	26 (32.5)
Systemic corticosteroids	12 (42.9)	7 (31.8)	5 (27.8)	4 (33.3)	28 (35.0)
Intravitreal triamcinolone	5 (17.9)	3 (13.6)	2 (11.1)	1 (8.3)	11 (13.8)
Anti-VEGF therapy	8 (28.6)	4 (18.2)	2 (11.1)	2 (16.7)	16 (20.0)
Combined steroids + anti-VEGF	6 (21.4)	2 (9.1)	1 (5.6)	1 (8.3)	10 (12.5)
Observation (self-limiting)	3 (10.7)	5 (22.7)	6 (33.3)	3 (25.0)	17 (21.3)
Visual Acuity Outcome at 12-Week Follow-Up					
Improved (≥ 2 LogMAR lines)	16 (57.1)	14 (63.6)	12 (66.7)	9 (75.0)	51 (63.8)
Stable (no change)	8 (28.6)	6 (27.3)	5 (27.8)	2 (16.7)	21 (26.3)
Worsened	4 (14.3)	2 (9.1)	1 (5.6)	1 (8.3)	8 (10.0)
Mean Follow-Up Duration (weeks)	14.2 ± 3.1	13.8 ± 2.7	12.9 ± 3.4	13.1 ± 2.9	13.7 ± 3.1
Recurrence of Uveitis	5 (17.9)	2 (9.1)	1 (5.6)	0 (0.0)	8 (10.0)
Complications					
Cataract development	4 (14.3)	2 (9.1)	1 (5.6)	0 (0.0)	7 (8.8)
Raised IOP (> 21 mmHg)	5 (17.9)	2 (9.1)	2 (11.1)	1 (8.3)	10 (12.5)
Persistent macular oedema	4 (14.3)	2 (9.1)	1 (5.6)	1 (8.3)	8 (10.0)
Epiretinal membrane	2 (7.1)	1 (4.5)	0 (0.0)	0 (0.0)	3 (3.8)
No complications	14 (50.0)	15 (68.2)	14 (77.8)	10 (83.3)	53 (66.3)
Overall Recovery Rate	24 (85.7)	20 (90.9)	17 (94.4)	11 (91.7)	72 (90.0)

Data expressed as n (%) or mean ± SD. IOP = Intraocular Pressure; Anti-VEGF = Anti-Vascular Endothelial Growth Factor; LogMAR = Logarithm of the Minimum Angle of Resolution.

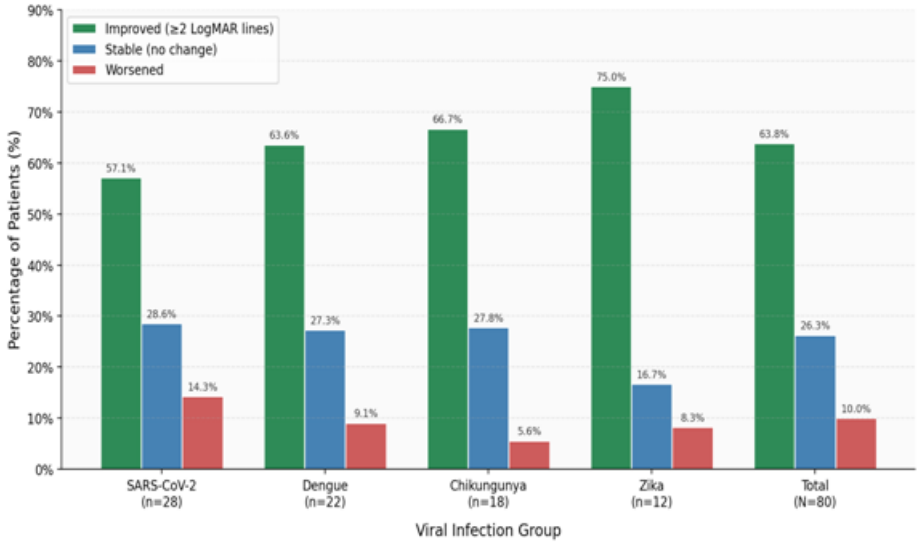

Figure 2: Visual Acuity Outcomes at 12-Week Follow-Up Across Viral Infection Groups.

The Zika virus group demonstrated the highest rate of improvement, while the SARS-CoV-2 group had the highest rate of worsening at follow-up.

Discussion

The present study provides a prospective, comparative characterisation of uveitis and retinal vascular complications across four emerging viral infections in a tertiary care setting in eastern India. To our knowledge, this is the first cohort from Bihar to compare all four viral aetiologies in a single observational study. Our principal finding—that SARS-CoV-2 infection is associated with the greatest burden of posterior segment and retinal vascular disease—aligns with international evidence and has implications for ophthalmological practice.[17]

The high prevalence of anterior uveitis across all groups (ranging from 66.7% in Zika to 71.4% in SARS-CoV-2 when considering any anterior segment finding) is consistent with established reports. Published reports document anterior segment inflammation in 57–73% of COVID-19 associated uveitis cases, with anterior uveitis as the predominant anatomical subtype.[13] Similarly, Mahendradas et al. in their multicentre Indian study reported anterior uveitis as the most frequent manifestation of chikungunya-related uveitis, occurring in approximately 42% of affected eyes, a finding congruent with our chikungunya cohort data.9 Our dengue cohort showed keratic precipitates in 22.7% and anterior chamber flare in 31.8%, which compare favourably with rates of 18–35% reported by Gupta et al. in a retrospective case series from North India.[19]

The retinal vascular complication burden in our SARS-CoV-2 cohort is particularly noteworthy. Retinal haemorrhage (28.6%), BRVO (25.0%), CRVO (17.9%), and retinal vasculitis (21.4%) collectively represented a significant cluster of posterior segment findings in this group. These data resonate with findings from Invernizzi et al. (2021), who conducted a prospective OCT-A study of COVID-19 survivors and identified retinal microvasculature abnormalities including increased vessel tortuosity, reduced foveal avascular zone area, and parafoveal flow deficits in a substantial proportion of patients even after recovery from systemic illness.[20] The hypercoagulable state induced by SARS-CoV-2—driven by elevated D-dimer, fibrinogen, and von Willebrand factor—provides a plausible pathophysiological substrate for the vascular occlusive events observed in our cohort.[6] Furthermore, the role of anti-phospholipid antibodies transiently elevated during COVID-19 may further compound retinal vascular thrombosis risk, as described by Avci et al. (2023) in their retrospective analysis of post-COVID retinal occlusions.[21] Macular oedema, identified by OCT in 32.1% of SARS-CoV-2 patients and 27.5% overall, represents a visually significant complication that may account for persistent visual impairment beyond the resolution of active inflammation. Similar rates of macular oedema have been documented in COVID-19 associated posterior uveitis in the published literature, and anti-VEGF therapy combined with corticosteroids—as employed in 21.4% of our SARS-CoV-2 patients—reflects current practice for combined inflammatory and ischaemic macular pathology, and aligns with recommendations emerging from post-COVID ophthalmic management guidelines.[22,23]

Dengue maculopathy and retinal haemorrhages, present in 27.3% and 31.8% of our dengue cohort respectively, are well-characterised sequelae of

dengue infection. The landmark study by Chan et al. (2006) established the clinical and angiographic features of dengue maculopathy, identifying foveal haemorrhage, disc oedema, and outer retinal disruption on OCT as key features.[24] More recently, Teoh et al. (2010), in a multicentre study, reported OCT patterns as predictors of visual outcome in dengue-related maculopathy, figures broadly concordant with our data.[25] The self-limiting nature of dengue ocular involvement in our series—with 22.7% managed by observation and 63.6% improving at 12 weeks—is consistent with the favourable natural history reported in prior literature.[7,25]

Chikungunya-related uveitis in our cohort demonstrated a predominantly anterior and bilateral pattern with a higher proportion of self-limiting disease (33.3% managed with observation) and the best visual recovery profile among arboviral groups at 12 weeks (66.7% improved). This is congruent with data from Mahendradas et al. (2008), who described anterior uveitis with fine keratic precipitates and occasional hyalitis in the majority of chikungunya-affected patients, with generally good visual prognosis.[9] A distinct Fuchs'-like iridocyclitis pattern in chikungunya has also been reported.[18] However, our data also document choroiditis in 16.7% of chikungunya patients, a rarer manifestation that has been reported in the context of CHIKV-associated retinitis in case series from India.[9,10]

The Zika cohort, though the smallest in our series (n=12), exhibited retinal haemorrhage in 33.3% and anterior chamber inflammation in 66.7%—among the highest rates recorded per enrolled patient. This resonates with reports from De Paula Freitas et al. (2016), who described macular chorioretinal scarring, retinal haemorrhages, and pigmentary disruption in both neonates and adults with Zika infection.[11] The high visual improvement rate in Zika patients (75.0%) likely reflects the milder severity of retinal vascular compromise, with predominantly inflammatory rather than ischaemic aetiology of visual disturbance.[12]

Bilateral ocular involvement was documented in 57.5% of our cohort overall, with SARS-CoV-2 showing the highest rate (64.3%). This symmetric pattern of inflammatory involvement has been attributed to haematogenous viral dissemination and systemic cytokine-mediated injury rather than direct intraocular replication in most cases.[4,17] Optic nerve involvement (disc oedema or optic neuritis), documented in 25.0% of SARS-CoV-2 patients, warrants particular clinical vigilance; para-infectious optic neuritis following COVID-19 has been increasingly reported in the literature, with Rodríguez-Rodríguez et al. (2023) describing a case series of 14 patients with SARS-CoV-2-associated optic neuritis, most of whom responded favourably to high-dose intravenous methylprednisolone.[26]

The 10.0% recurrence rate of uveitis in our overall cohort—disproportionately concentrated in the SARS-CoV-2 group (17.9%)—suggests that COVID-19 associated uveitis may behave more like a chronic or relapsing inflammatory condition compared to classic arboviral uveitis. This may reflect persistent viral antigen-driven immune activation or molecular mimicry-based autoimmunity, as reviewed by Wildner (2023) in their analysis of antigenic mimicry as a driver of autoimmune uveitis in immune-privileged sites.[27] Complications including steroid-induced raised IOP (12.5%) and cataract formation (8.8%) were manageable within our follow-up period and underscore the necessity of regular monitoring during corticosteroid therapy.

Limitations of the present study include its single-centre design, the relatively small sample size particularly for Zika virus (n=12; post-hoc power for pairwise comparisons 26–37%), and the 12-week follow-up duration which may not capture late recurrences or complications. Additionally, the absence of anterior chamber tap for viral PCR limits definitive confirmation of direct intraocular viral involvement. Future multicentre prospective studies with longer follow-up and molecular confirmation of intraocular viral presence are warranted to further delineate pathogenic mechanisms and refine management protocols for viral uveitis in the Indian context.

Conclusion

Emerging viral infections—specifically SARS-CoV-2, dengue, chikungunya, and Zika virus—cause a diverse and occasionally sight-threatening spectrum of uveitis and retinal vascular complications. SARS-CoV-2 infection is associated with the greatest severity and recurrence risk, characterised by macular oedema, retinal vascular occlusions, and optic nerve involvement, while arboviral infections tend to present with predominantly anterior uveitis and a more favourable visual prognosis. Bilateral involvement is common across all aetiologies. Systematic ophthalmic evaluation should be performed in all patients with confirmed emerging viral infections, even in the absence of visual symptoms at systemic presentation.

Treatment guided by anatomical subtype and inflammation severity—including corticosteroids, anti-VEGF agents, and intravitreal therapy as indicated—achieved a 90.0% recovery rate at 12-week follow-up. These findings underscore the need for integrating structured ophthalmological assessment into the clinical management protocols of emerging infectious disease in the post-pandemic era.

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Data Availability: The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

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