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Emerging Causes of Viral-Associated Uveitis

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Introduction

The differential diagnosis of patient with uveitis may be complex depending on the presenting clinical symptoms and signs. Based on the clinical features, both infectious and noninfectious causes should be considered. While treatment with corticosteroids either via local or systemic administration may be appealing for many patients with active inflammation, ruling out an infectious process is essential to avoid exacerbation of infectious uveitis in some patients. Viral causes of anterior uveitis and posterior uveitis must be considered in the differential diagnosis prior to initiation of therapy. The following is an overview of viral entities that should be considered when evaluating patients with uveitis.

West Nile Chorioretinitis

West Nile virus (WNV) is an RNA arbovirus and part of the Flaviviridae family. This family includes the viruses responsible for Japanese encephalitis, St. Louis encephalitis, yellow fever, dengue, Murray Valley encephalitis, Kunjin encephalitis, and Western equine encephalitis¹. Wild birds are the natural hosts and disease is transmitted to humans via mosquitoes from infected birds¹. The first documented case in North America occurred in New York in 1999 and the virus has subsequently spread throughout the continental United States. The incubation period typically ranges from 3–14 days². Diagnosis requires a high index of clinical suspicion and appropriate serologic testing. Serology is rapid and relatively inexpensive, however it is not specific because of cross reactivity with other flavivirus infections³. The most common diagnostic test is an enzyme linked immunosorbent assay (ELISA) to detect WNV specific IgM⁴. Increased specificity can be achieved using molecular diagnostic assays and include real time RT-PCR and RT-LAMP. While the majority of cases of West Nile are asymptomatic, when symptoms do occur, there is typically high-grade fever, weakness, headache, myalgia, and GI upset. More serious manifestations include meningitis, encephalitis, or meningoencephalitis. This occurs in 0.67–1% of those infected⁵. Treatment of systemic infection is typically supportive⁶.

Most patients with ocular involvement typically complain of mildly reduced vision, photophobia, and floaters². These symptoms occur concomitantly with signs of systemic infection⁴. Less commonly complaints can include a severe reduction in vision, retrobulbar pain, and diplopia⁵.

The chorioretinitis of WNV has been described in up to 80% of patients with seropositive acute WNV infection and was most often asymptomatic⁶. In most patients there is a mild vitreous reaction; this is in contrast to other causes of retinitis with more pronounced vitreous inflammation including acute retinal necrosis, toxoplasmosis, herpetic retinitis, and Behcets. Most patients with ocular disease were older than 50 years and had a higher rate of diabetes mellitus^{1,11}.

The multifocal chorioretinitis presents similarly to multifocal choroiditis and manifests as scattered or linear deep, creamy retinal lesions^{3,4,10}. In contrast to multifocal choroiditis lesions appear and resolve together and are not in varying stages of resolution. These lesions average about 500 microns in diameter and are most common in the periphery rather than in the poster pole^{2,8}. A linear distribution has been described in up to 80 % of eyes with WNV chorioretinitis and are typically in a radial or curvilinear orientation^{6,7}. Khairallah et al. proposed that these linear clusters, or streaks, follow the contour of the RNFL. They propose that this pattern supports the hypothesis that WNV extends contiguously from the central nervous system via the optic nerve, and the chorioretinitis is not the result of hematogenous spread via the choriocapillaris⁷. In the subacute stage of the disease process lesions become partially pigmented and atrophic with a surrounding creamy edge. In the convalescent stage lesions become pigmented and atrophic with well-demarcated borders¹ (Figure 1). The chorioretinitis appears to be self-limited but may increase the risk of choroidal neovascularization over time⁴. The differential diagnosis of WNV chorioretinitis should include syphilis, tuberculosis, sarcoidosis, multifocal choroiditis, and ocular histoplasmosis⁴.

Active lesions may be imaged by fluorescein angiography and demonstrate characteristic central hypofluorescence with hyperfluorescent edges consistent with peripheral leakage^{2,3,9}. These have been described as “target lesions”. Inactive lesions are hyperfluorescent in the early phases and stain in the late phases⁴. Other imaging methodologies including indocyanine green angiography show intensely hypofluorescent lesions that do not increase in size with time⁵. It has been postulated that these hypofluorescent areas are the result of blocking and correlate with the deep, creamy lesions viewed on fundoscopic exam. SD-OCT through these retinal lesions shows hyperreflectivity in the deep retinal layers with sparing of the inner retina and RNFL⁵.

Ebola Virus Associated Uveitis

There is limited information on the ocular effects of Ebola (EBO). However the recent outbreak centered in West Africa has increased public awareness and stoked considerable interest in the disease. The Ebola virus is a non-segmented, negative sense, single stranded RNA virus in the Filoviridae family¹². Diagnosis of Ebola virus is made by rapid antigen capture ELISA and confirmed with RT-PCR assay. In the early stages of infection, ophthalmic findings include conjunctival injection, subconjunctival hemorrhage, and in some cases, a bilateral conjunctivitis. In the 1995 Yambou outbreak, 58% of patients had conjunctival injection at presentation. In that same year the Kikwit outbreak documented patients who presented with decreased vision and blindness during an acute Ebola virus

illness. There was no ophthalmic personal to examine these patients, but this suggests that patients with an acute Ebolavirus infection may have more severe ocular manifestations.¹⁴

A case series from the Democratic Republic of the Congo followed 20 EBO survivors of whom 4 patients developed ocular complaints¹³. During the convalescent phase of their illness (42–72 days after diagnosis) these patients complained of symptoms of ocular pain, photophobia, hyperlacrimation, and vision loss consistent with a diagnosis of uveitis. The posterior segment was involved in 2 of the 4 patients. Anterior uveitis was diagnosed in 2 cases with an intermediate uveitis in one patient and an intermediate/posterior uveitis in the last patient. All patients were treated with topical cycloplegics and corticosteroids and all patients recovered over a period of several weeks.

With the spread of EBO to Western countries and the outbreak in West Africa still requiring improved control, it is likely that more patients will present in the United States.

Understanding the ocular manifestations of this disease will be important, as the expertise of the ophthalmologist may be required in the management of these patients.

HTLV-1 associated uveitis

Human T lymphocyte virus type 1 (HTLV-1) is human retrovirus that targets CD4 lymphocytes of the adaptive immune system^{15,16}. Transmission occurs via sexual contact, blood transfusion, and through breast milk¹⁷. Infection has been associated with the development of adult T cell leukemia/lymphoma as well as inflammatory disorders of the CNS including HTLV-1 associated myelopathy/tropical spastic paraparesis. HTLV-1 is highly endemic in certain areas of the world including Southern Japan, the Caribbean, and central Africa.^{15,18}. Inflammation is caused by intraocular infiltration of HTLV-1 infected T cells, viral gene expression, and release of cytokines including IL-6^{15,19}.

Diagnosis is typically made with serum antibody to HTLV-1 by particle agglutination assay or ELISA. Aqueous samples demonstrate antibody to HTLV-1 by PCR in up to 100% of those with HTLV-1 associated uveitis (HAU)^{18,20}. Measurement of serum soluble interleukin-2 receptor in those with HAU is significantly higher than in healthy controls¹⁸.

HAU occurs most frequently in middle-aged women and generally has a favorable visual prognosis¹⁵. Yamaguchi et al. demonstrated a significant association between seropositivity for HTLV-1 and Graves Disease. While the mechanism behind this association is unclear, they postulate that changes in the immune system as a result of the virus may predispose to autoimmune disease²¹.

Manifestations of disease most commonly include fine vitreous cell with lacy membranous opacities or snowball-like deposits^{18,22}. While intermediate uveitis is the most common presentation, anterior uveitis and panuveitis can also occur. Retinal vascular changes including vasculitis and neovascularization are uncommon^{15,22}. It is most often a unilateral process but can be bilateral in 43%¹⁸. The severity of inflammation is fairly mild and visual prognosis is good suggestive of an immunopathogenetic process as opposed to a cytopathic mechanism¹⁹.

The use of ICGA in HTLV-1 associated uveitis demonstrates choroidal lesions, which are difficult to detect on fundus exam and on fluorescein angiography. Imaging reveals scattered hypercyanescent lesions in the posterior pole as well as ICG leakage from the choroidal vasculature²³. These hypercyanescent spots are consistent with a staining phenomenon.

The uveitis responds well to therapy with corticosteroids either topically or systemically administered however it is frequently recurrent with cessation of therapy^{17,18}. Intervals of quiescence can be as long as 2 years and as short as several weeks¹⁸.

Coxsackie Virus-Associated Unilateral Acute Idiopathic Maculopathy

Unilateral acute idiopathic maculopathy (UAIM) is a rare cause of acute monocular visual loss first described by Yannuzzi et al. in 1991. It represents an inflammatory process involving the outer retina and retinal pigment epithelium (RPE) of the macula²⁴. It most frequently affects otherwise healthy young adults and is associated with a prodromal flu like illness²⁴. The disease is typically self-limited and associated with spontaneous return of vision between 6 weeks and 6 months²⁵. It has been postulated that coxsackie virus may be the etiologic virus responsible for this condition²⁵. Coxsackie virus is a member of the picornaviridae family, which are single-stranded positive sense RNA viruses. Hand-foot-mouth disease is the common systemic presentation of coxsackie virus infection with type A16 being the most frequent, although serotypes A2, A5, A7, A9, A10, B1, B2, B3, B4, B6, and enterovirus 71 have also been found to be causative^{24,26}. Coxsackie virus serotypes B3 and B4 have also been associated with posterior segment inflammation^{26,27}. In vitro studies have demonstrated the ability of the virus to replicate inside retinal pigment epithelial (RPE) cells²⁷.

Hand-foot-mouth disease is most prevalent in the late summer to early fall. Outbreaks are frequent in schools and daycare, and oftentimes those with UAIM report family members with hand-foot-mouth disease²⁷. In the correct clinical context in which UAIM is suspected, viral titers for coxsackie virus should be drawn and should include acute and convalescent sera^{24,28}.

Fundus examination reveals unilateral, irregular pigmentary changes and occasionally a neurosensory detachment involving the macula²⁷. Fundus autofluorescence reveals an abnormal stippled pattern in the acute phase, which evolves into a more stellate pattern during the later stages of disease. There is also loss of background autofluorescence suggestive of a loss of foveal and parafoveal RPE cells²⁷. High speed ICGA can reveal dilated choroidal vessels with surrounding “moth eaten” vessels, which suggests an inflammatory process involving the choroid in addition to disruption of the RPE²⁷. SD-OCT characteristically reveals hyperreflective subretinal material and can also demonstrate neurosensory detachment²⁷. The etiology of the hyperreflective material is unclear but may represent damaged photoreceptor outer segments²⁷. This appearance suggests abnormality at the level of the RPE (Figure 2). While resolution of the hyperreflective subretinal material is rapid, visual recovery lags behind until the ellipsoid zone has been restored. These changes resolve with return of vision although a ‘Bull’s eye’ scar may persist after the inflammation has regressed.

Whether UAIM is the result of direct viral infection or is related to an autoimmune process in the setting of viral infection in susceptible individuals is unclear. Therefore treatment of this typically self-limited infection with corticosteroids is not advised²⁷.

Seasonal Hyperacute Panuveitis

Seasonal hyperacute panuveitis (SHAPU) is a rare, potentially blinding disease characterized by fulminant diffuse ocular inflammation. It has been described previously in Nepal and most often affects young, healthy children²⁹. The etiology remains unclear, although a viral cause has been proposed^{29,30}. Epidemics appear to follow a 2 year cycle and an association with white Tussock moths has been postulated.^{29,31}

Patients typically present with sudden, unilateral eye redness, vision loss, and leukocoria. A hypopyon with a dense fibrinoid reaction in the anterior chamber is commonly observed²⁹. Intraocular pressure decreases resulting in hypotony³¹. Vision loss is dramatic and occurs very early in the disease process. SHAPU may be more accurately referred to as an endophthalmitis rather than a panuveitis given its severe presentation. Despite early medical intervention, most patients lose all vision and the eye rapidly becomes phthisical requiring enucleation²⁹. Pathology of the enucleated eyes reveals chronic inflammatory cells, lymphocytes, and plasma cells³¹.

Early vitrectomy has been effective in restoring some vision in patients with SHAPU and if suspected should be performed as soon as possible³¹. Up to 50% of patients who underwent early vitrectomy gained a vision better than 6/60³¹.

Torque teno virus, of the family anelloviridae, are non-enveloped viruses with a circular, single stranded DNA genome. Smits et al. found that using PCR of vitreous fluid samples in patients with SHAPU vs controls that there was a significantly higher prevalence of torque teno virus in affected individuals. 1 case of SHAPU out of India did demonstrate VZV in anterior chamber aspirate. Treatment with IV acyclovir and oral corticosteroids resulted in improvement in vision and resolution of the inflammation³⁰. However other studies have not corroborated an increased incidence of VZV in these patients.

The mechanism by which white moths may transmit this virus to the eye is unknown. It has been shown that ocular penetrating caterpillar or tarantula hair can cause a diffuse severe ocular inflammation and it is possible that the hair of the white moth may penetrate the cornea of those infected. The hair of the white moth has been found in the cornea and anterior chamber of patients with SHAPU. The inflammation caused by the moth hair could disrupt the blood ocular barrier allowing anelloviruses into the vitreous cavity from the blood stream²⁹. Further research will be required to confirm this hypothesis.

Fuchs Heterochromic Iridocyclitis

Fuchs Heterochromic Iridocyclitis (FHI) is purported to represent 2–7% of all causes of anterior uveitis in North America^{32,33,34}. Diagnostic criteria include diffuse stromal atrophy and patchy loss of the iris pigment epithelium; small, white “stellate” keratic precipitates; and minimal anterior chamber and vitreous cell/flare^{32,34}. The process is unilateral and the

affected eye is usually heterochromic. Patients are typically asymptomatic or present with decreased vision secondary to cataracts or increased vitreous floaters. Conjunctival injection and photophobia are usually absent^{32,33}.

Taking aqueous samples from patients with FHI, Quentin et al. determined that rubella antibody synthesis was present in all eyes tested. The rubella virus is a positive sense, enveloped RNA togavirus. While this strongly supports rubella as the causative virus the mechanism by which this occurs is still unknown. Treatment of FHI is supportive and includes addressing cataracts and glaucoma. Corticosteroids are not recommended routinely.

Posner-Schlossman Syndrome

Posner-Schlossman Syndrome (PSS) is a uncommon form of secondary open angle glaucoma. It typically affects young to middle age patients and presents with episodes of very elevated intraocular pressure in the setting of a mild, non-granulomatous anterior uveitis^{35,36}. Bloch-Michel et al. demonstrated CMV positivity in 7/11 cases of PSS through PCR analysis of aqueous humor. The remaining patients did not show positivity to any other antigen tested including HSV, VZV, and measles virus³⁷. CMV is a dsDNA virus in the herpesviridae family.

The raise in IOP is caused by trabecular outflow obstruction secondary to inflammatory changes³⁵. On clinical examination a mild ciliary flush is present along with corneal edema and fine stellate like keratic precipitates mostly in the central and inferior cornea³⁵. There may be iris heterochromia. The lack of posterior synechiae and peripheral anterior synechiae is a key feature of PSS³⁵. The rise in IOP is typically out of proportion to the degree of inflammation³⁵. PSS responds well to topical steroids with a fast taper. Aqueous suppressants can be used to control IOP. Unless there is underlying primary open angle glaucoma, these agents do not need to be used between episodes.

Herpetic Viral Infections

One of the most common and more concerning causes of inflammation, the herpes viruses are responsible for a variety of conditions affecting the eye. They are an important cause of anterior uveitis as well as posterior uveitis including acute retinal necrosis and progressive outer retinal necrosis. Because of the wide variety of presentations observed with herpetic ocular infections including keratitis, anterior uveitis, intermediate uveitis, and retinitis including acute retinal necrosis, consideration of herpes simplex virus infection in the differential diagnosis of uveitis is paramount for many patients. A comprehensive review of 'acute retinal necrosis' is beyond the scope of this review but is summarized in another chapter of this issue.

Conclusion

The visual prognosis and treatment of viral uveitis is dependent on the virus responsible and the ability of the ophthalmologist to accurately diagnose the condition. In some patients, observation may be elected while in others including HTLV-associated inflammation, vitrectomy may be indicated because of the risk of T-cell lymphoma/leukemia. As molecular

diagnostic testing improves and becomes more widely available, it is likely that our diagnostic capabilities and understanding of the disease processes will improve as well.

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References

1. Chan, Clement K.; Limstrom, Scott A.; Tarasewicz, Dariusz G.; Lin, Steven G. Ocular Features of West Nile Virus in North America. *Ophthalmology*. 2006; 113.9:1539–1546. [PubMed: 16860390]
2. Bakri, Sophie J.; Kaiser, Peter K. Ocular Manifestations of West Nile Virus. *Current Opinion in Ophthalmology*. 2004; 15.6:537–540. [PubMed: 15523200]
3. Sivakumar, Rathinam R.; Prajna, Lalitha; Arya, Lalan Kumar; Muraly, Praveen; Shukla, Jyoti; Saxena, Divyasha; Parida, Manmohan. Molecular Diagnosis and Ocular Imaging of West Nile Virus Retinitis and Neuroretinitis. *Ophthalmology*. 2013; 120.9:1820–1826. [PubMed: 23642374]
4. Garg, Seema; Jampol, Lee M. Systemic and Intraocular Manifestations of West Nile Virus Infection. *Survey of Ophthalmology*. 2005; 50.1:3–13. [PubMed: 15621074]
5. Learned, Daniel; Nudleman, Eric; Robinson, Joshua; Chang, Emmanuel; Stec, Lori; Faia, Lisa J.; Wolfe, Jeremy; Williams, George A. Multimodal Imaging Of West Nile Virus Chorioretinitis. *Retina*. 2014; 34:2269–2274. [PubMed: 25337661]
6. Khairallah M, Yahia S Ben, Attia S, Zaouali S, Ladjimi A, Messaoud R. Linear Pattern of West Nile Virus-associated Chorioretinitis Is Related to Retinal Nerve Fibres Organization. *Eye*. 2006; 21.7:952–955. [PubMed: 16628235]
7. Khairallah M, Benyahia S, Ladjimi A, Zeghidi H, Benromdhane F, Besbes L, Zaouali S, Messaoud R. Chorioretinal Involvement in Patients with West Nile Virus Infection? *Ophthalmology*. 2004; 111.11:2065–2070. [PubMed: 15522373]
8. Anninger, William; Lubow, Martin. Visual Loss with West Nile Virus Infection: A Wider Spectrum of a ?New? Disease. *Clinical Infectious Diseases*. 2004; 38.7:E55–E56. [PubMed: 15034847]
9. Shaikh S. West Nile Virus Chorioretinitis. *British Journal of Ophthalmology*. 2004; 88.12:1599–1560. [PubMed: 15548822]
10. Vandenbelt, Scott; Shaikh, Saad; Capone, Antonio; Williams, George A. Multifocal Choroiditis Associated With West Nile Virus Encephalitis. *Retina*. 2003; 23.1:97–99. [PubMed: 12652239]
11. Afshar, Armin R.; Hariprasad, Seenu M.; Jampol, Lee M.; Sheth, Veeral S. Use of Intravitreal Bevacizumab to Treat Macular Edema in West Nile Virus Chorioretinitis. *Archives of Ophthalmology*. 2012; 130.3:396–398. [PubMed: 22411674]
12. Bishop, Bryan M. Potential and Emerging Treatment Options for Ebola Virus Disease. *Annals of Pharmacotherapy*. 2014:1–11.
13. Kibadi, Kapay; Mupapa, Kibadi; Kuvula, Kivudi; Massamba, Matondo; Ndaberey, Djuma; Muyembe- Tamfum, JJ.; Bwaka, Mpia Ado; De Roo, Ann; Colebunders, Robert. Late Ophthalmologic Manifestations in Survivors of the 1995 Ebola Virus Epidemic in Kikwit, Democratic Republic of the Congo. *The Journal of Infectious Diseases*. 1999; 179.S1:S13–S14. [PubMed: 9988158]
14. Towner JS, Rollin PE, Bausch DG, Sanchez A, Crary SM, Vincent M, Lee WF, Spiropoulou CF, Ksiazek TG, Lukwiya M, Kaducu F, Downing R, Nichol ST. Rapid Diagnosis of Ebola

Hemorrhagic Fever by Reverse Transcription-PCR in an Outbreak Setting and Assessment of Patient Viral Load as a Predictor of Outcome. *Journal of Virology*. 2004; 78.8:4330–4341. [PubMed: 15047846]

15. Kase, Satoru; Namba, Kenichi; Kitaichi, Nobuyoshi; Iwata, Daiju; Ohno, Shigeaki; Ishida, Susumu. Clinical Features of Human T Lymphotropic Virus Type 1-associated Uveitis in Hokkaido, Japan. *Japanese Journal of Ophthalmology*. 2013; 57.4:379–384. [PubMed: 23608951]
16. Ono, Ayako; Miura, Tomoyuki; Araki, Shinji; Yamaguchi, Kazunari; Takatsuki, Kiyoshi; Mori, Sigeo; Hayami, Masanori; Mochizuki, Manabu; Watanabe, Toshiki. Subtype Analysis of HTLV-1 in Patients with HTLV-1 Uveitis. *Cancer Science*. 1994; 85.8:767–770.
17. Merle, Harold; Cabre, Philippe; Olindo, Stéphane; Merle, Sylvie; Smadja, Didier. Ocular Lesions in 200 Patients Infected by the Human T-cell Lymphotropic Virus Type 1 in Martinique (French West Indies). *American Journal of Ophthalmology*. 2002; 134.2:190–195. [PubMed: 12140025]
18. Mochizuki M, Watanabe T, Yamaguchi K, Tajima K, Yoshimura K, Nakashima S, Shirao M, Araki S, Miyata N, Mori S, Takatsuki K. Uveitis Associated with Human T Lymphotropic Virus Type I: Seroepidemiologic, Clinical, and Virologic Studies. *Journal of Infectious Diseases*. 1992; 166.4:943–944. [PubMed: 1527436]
19. Kaminagayoshi, Tatsuhiko; Nakao, Kumiko; Yashiki, Shinji; Sonoda, Shunro; Ohba, Norio; Sakamoto, Taiji. Analysis of HLA Class I and Class II Gene Polymorphisms in Japanese Patients with Human T-Cell Lymphotropic Virus Type 1-Associated Uveitis. *Ocular Immunology and Inflammation*. 2005; 13.2-3:199–204. [PubMed: 16019679]
20. Sagawa K, Mochizuki M, Masuoka K, Katagiri K, Katayama T, Maeda T, Tanimoto A, Sugita S, Watanabe T, Itoh K. Immunopathological Mechanisms of Human T Cell Lymphotropic Virus Type 1 (HTLV-I) Uveitis. Detection of HTLV-I-infected T Cells in the Eye and Their Constitutive Cytokine Production. *Journal of Clinical Investigation*. 1995; 95.2:852–858. [PubMed: 7860769]
21. Yamaguchi K, Mochizuki M, Watanabe T, Yoshimura K, Shirao M, Araki S, Miyata N, Mori S, Kiyokawa T, Takatsuki K. Human T Lymphotropic Virus Type 1 Uveitis after Graves' Disease. *British Journal of Ophthalmology*. 1994; 78.3:163–166. [PubMed: 8148330]
22. Nakao K, Ohba N. Clinical Features of HTLV-I Associated Uveitis. *British Journal of Ophthalmology*. 1993; 77.5:274–279. [PubMed: 8100446]
23. Sakurai, Toshiya; Yukawa, Eiichi; Hara, Yoshiaki; Miyata, Norio; Mochizuki, Manabu. Indocyanine Green Angiography in Patients with Human T Cell-lymphotropic Virus Type 1 Uveitis. *Graefes's Archive for Clinical and Experimental Ophthalmology*. 2002; 240.2:101–105.
24. Beck AP. Is Cocksackievirus the Cause of Unilateral Acute Idiopathic Maculopathy? *Archives of Ophthalmology*. 2004; 122.1:121–123. [PubMed: 14718310]
25. Hughes, Edward H.; Hunyor, Alex P.; Gorbатов, Mark; Ho, I-Van. Acute Idiopathic Maculopathy With Cocksackievirus Infection. *Retinal Cases & Brief Reports*. 2012; 6.1:19–21. [PubMed: 25390701]
26. Haamann, Per; Kessel, Line; Larsen, Michael. Monofocal Outer Retinitis Associated with Hand, Foot, and Mouth Disease Caused by Cocksackievirus. *American Journal of Ophthalmology*. 2000; 129.4:552–553. [PubMed: 10764878]
27. Jung CS, Payne JF, Bergstrom CS, Cribbs BE, Yan J, Hubbard GB, Olsen TW, Yeh S. Multimodality Diagnostic Imaging in Unilateral Acute Idiopathic Maculopathy. *Archives of Ophthalmology*. 2012; 130.1:50–56. [PubMed: 22232475]
28. Kadrmas, Eddief; Buzney, Sheldonm. Cocksackievirus B4 as a Cause of Adult Chorioretinitis. *American Journal of Ophthalmology*. 1999; 127.3:347–349. [PubMed: 10088751]
29. Smits SL, Manandhar A, Van Loenen FB, Van Leeuwen M, Baarsma GS, Dorrestijn N, Osterhaus ADME, Margolis TP, Verjans GMGM. High Prevalence of Anelloviruses in Vitreous Fluid of Children With Seasonal Hyperacute Panuveitis. *Journal of Infectious Diseases*. 2012; 205.12:1877–1884. [PubMed: 22492851]
30. Biswas, Jyotirmay; Gopal, Lingam; Kathil, Pratima. Demonstration of Varicella Zoster Virus in a Case of Presumed Seasonal Hyperacute Panuveitis. *Indian Journal of Ophthalmology*. 2005; 53.4:270–272. [PubMed: 16333178]
31. Shrestha E. A Profile and Treatment Outcome of Seasonal Hyper-acute Panuveitis. *Nepalese Journal of Ophthalmology*. 2010; 2.3:35–38. [PubMed: 21141325]

32. Liu, Yao; Takusagawa, Hana L.; Chen, Teresa C.; Pasquale, Louis R. Fuchs Heterochromic Iridocyclitis and the Rubella Virus. *International Ophthalmology Clinics*. 2011; 51.4:1–12. [PubMed: 21897135]
33. Quentin, Claus D.; Reiber, Hansotto. Fuchs Heterochromic Cyclitis: Rubella Virus Antibodies and Genome in Aqueous Humor. *American Journal of Ophthalmology*. 2004; 138.1:46–54. [PubMed: 15234281]
34. Groot-Mijnes, Jolanda Df De; De Visser, Lenneke; Rothova, Aniki; Schuller, Margje; Van Loon, Antonv M.; Weersink, Annemarie JI. Rubella Virus Is Associated With Fuchs Heterochromic Iridocyclitis. *American Journal of Ophthalmology*. 2006; 141.1 212–14.e1.
35. Shazly, Tarek A.; Aljajeh, Mouhab; Latina, Mark A. Posner–Schlossman Glaucomatocyclitic Crisis. *Seminars in Ophthalmology*. 2011; 26.4-5:282–284. [PubMed: 21958175]
36. Teoh SB, Thean L, Koay E. Cytomegalovirus in Etiology of Posner-Schlossman Syndrome: Evidence from Quantitative Polymerase Chain Reaction. *Eye*. 2005; 19.12:1338–1340. [PubMed: 15543169]
37. Bloch-Michel E, Dussaix E, Cerqueti P, Patarin D. Possible Role of Cytomegalovirus Infection in the Etiology of the Posner-Schlossmann Syndrome. *International Ophthalmology*. 1987; 11.2:95–96. [PubMed: 2833455]

Figure 1.

Fundus photograph (top left) shows punched-out lesions characteristic of West Nile chorioretinitis. There is an inferotemporal retinal hemorrhage indicative of prior vasculitis. Fluorescein angiogram (top right) shows window defects and mild hyperfluorescence of the perifoveal vessels. Near-infrared image for registration (lower left) and spectral-domain optical coherence tomography scan (lower right) highlights the loss of the ellipsoid layer and outer retinal architectural disruption in the areas of the punched-out lesions.

Figure 2.

Fundus photograph (top left) of patient with Coxsackievirus-associated unilateral acute idiopathic maculopathy shows granular appearance of retinal pigment epithelium. Corresponding venous frame fluorescein angiogram (top right) shows stippled hyperfluorescence surrounding the foveal region. Horizontal spectral-domain optical coherence tomography scan (lower left) shows attenuation of the ellipsoid layer and outer retinal changes temporal to the fovea. A vertical SD-OCT scan (lower right) shows similar changes corresponding to attenuation of the ellipsoid layer both superior and inferior to the fovea.

Table 1

Summary of viral entities associated with uveitis

	Virus Classification	Presentation	Treatment	Major Complications
West Nile Chorioretinitis	RNA arbovirus	multifocal chorioretinitis	supportive	none
Ebola associated uveitis	RNA filovirus	anterior and posterior uveitis	cycloplegia and steroids	none
HTLV-1 associated uveitis	RNA retrovirus	intermediate uveitis	steroids	CNV
Coxsackie virus associated unilateral acute idiopathic maculopathy	RNA picornavirus	posterior uveitis	supportive	none
Seasonal hyperacute panuveitis	ssDNA anellovirus	panuveitis	early vitrectomy	phthisis bulbi
Fuchs heterochromic iridocyclitis	RNA togavirus	anterior uveitis	supportive	Cataract, glaucoma
Posner Schlusman Syndrome	dsDNA herpesvirus	anterior uveitis	steroids and aqueous suppressants	secondary open angle glaucoma