Uveitis in Adults: A Review

Panayiotis Maghsoudlou PhD[1,2], Simon J. Epps MRCP[2], Catherine M. Guly MRCOPhth[2], Andrew D. Dick MD[1,3,4,5]

[1] Academic Unit of Ophthalmology, Translational Health Sciences, Bristol Medical School, University of Bristol, Bristol BS8 1QU, UK

[2] Regional Ocular Inflammatory Service, Bristol Eye Hospital, Bristol BS1 2LX, UK

[3] School of Cellular and Molecular Medicine, University of Bristol, University Walk, BS8 1TD

[4] UCL Institute of Ophthalmology, London EC1V 9EL, UK

[5] NIHR - Biomedical Research Centre, Moorfield's and UCL - Institute of Ophthalmology, UK.

***Corresponding Author:**

Prof. Andrew D. Dick

Duke Elder Chair & Director of Institute Ophthalmology

UCL Institute of Ophthalmology

11-43 Bath St, London EC1V 9EL

a.dick@ucl.ac.uk

+44 (0) 207 608 6800

Word count: 4,132

Abstract

Importance: Uveitis is characterized by inflammation of the uvea, the middle portion of the eye composed of the iris, ciliary body and choroid, causing eye redness, pain, photophobia, floaters and blurred vision. Untreated uveitis may cause cataracts, glaucoma, macular edema, retinal detachment, optic nerve damage, and vision loss.

Observations: Uveitis predominantly affects individuals aged 20 to 50 years. Anterior uveitis affects the iris and ciliary body (41-60% of cases), intermediate uveitis affects the pars plana (attachment point of vitreous humor) and peripheral retina (9-15%), posterior uveitis involves the choroid and/or retina (17-23%), and panuveitis involves all uveal layers (7-32%). Uveitis is classified as non-infectious or infectious, with toxoplasmosis, herpes, TB, and HIV comprising 11-21% of infectious cases in high-income countries and 50% in low- and middle-income countries. Incidence and prevalence of uveitis are influenced by genetic (e.g., HLA-B27) factors, environmental factors (e.g., air pollution) and infection rates. In the US and Europe, 27-51% of uveitis cases are idiopathic, and 37-49% are associated with systemic disease, such as axial spondyloarthritis. Treatment goals are to induce and maintain remission while minimizing corticosteroid use to reduce corticosteroid-related adverse effects. Infectious uveitis requires systemic antimicrobial treatment. Active inflammatory disorders associated with uveitis should be treated by the appropriate specialist (e.g. rheumatologist). Treatment for uveitis depends on subtype; anterior uveitis is treated with topical corticosteroids, and mild intermediate uveitis may be monitored without initial treatment. Patients with moderate to severe intermediate uveitis, posterior uveitis, and panuveitis are at high risk of sight-threatening complications and require systemic and/or intravitreal corticosteroids and immunosuppressive agents. For posterior uveitis, first-line therapy with disease-modifying antirheumatic drugs (DMARDs) such as methotrexate achieved remission of inflammation in 52.1% (95%CI: 38.6–67.1), and mycophenolate mofetil controlled inflammation in 70.9% (95%CI: 57.1–83.5). In patients who do not improve or worsen with first-line therapy, adalimumab extended time-to-treatment failure to 24 weeks vs. 13 weeks with placebo and reduced frequency of treatment failure from 78.5% to 54.5% (P<0.001).

Conclusions and Relevance: Uveitis is characterized by inflammation of the uvea and primarily affects adults aged 20 to 50 years. For non-infectious anterior uveitis, corticosteroid eyedrops are first-line treatment. For posterior non-infectious uveitis, DMARDs are first-line therapy; biologics such as adalimumab are second-line treatment for patients with inflammation refractory to treatment. Uveitis caused by systemic infection should be treated with antimicrobials, and local or systemic steroids may be used depending on the severity of uveitis and the specific microorganism.

Introduction

Uveitis affects 38-714 per 100,000 people worldwide, is reported to be associated with 3-10% of vision impairment in the US and Europe based on studies many of which are from almost 30 years ago, and has been reported to be associated with up to a quarter of cases of blindness in low and middle-income countries.[1] In a retrospective analysis of US insurance claims (1998–2012), 5% of patients with non-infectious intermediate uveitis, posterior uveitis, or panuveitis developed blindness or low vision over 5 years .[2] Uveitis involves inflammation of the uvea, which consists of the iris, ciliary body and the choroid. Symptoms include eye pain, redness, photophobia, and vision loss. Prompt ophthalmologic evaluation is needed to assess severity, determine etiology, and initiate treatment.

Uveitis has various etiologies, including autoimmune diseases (e.g. multiple sclerosis; 1%),[1] systemic immune-mediated inflammatory diseases (e.g. sarcoidosis; 2-17%)[3-7] and autoinflammatory diseases (rare genetic disorders affecting the immune system such as Blau syndrome); infections (including TB [1-13%], syphilis [1-4%], HIV [1-14%], and toxoplasmosis [5-7%])[8-10]; and adverse reactions to medications (e.g. immune checkpoint inhibitors, <0.5%).[11-14] Masquerade syndromes are ocular conditions with intraocular infiltrating cells such as lymphoma (1-5%).[15] There is geographic variation in the etiology and presentation of uveitis due to variation in the prevalence of risk factors such as infections, air pollution, and tobacco smoking and of genetic variables.[16,17] The underlying cause of uveitis is unidentified in 27-51% of cases, termed idiopathic uveitis.[5,11,18-20]

This review summarizes current evidence regarding pathophysiology, epidemiology, diagnosis and treatment of uveitis in adults.

Methods

MEDLINE and Embase were searched (January 1, 2000 - March 1, 2025 using keywords and MeSH headings related to epidemiology, pathophysiology, diagnosis, management, and prognosis of uveitis. We prioritized articles according to study quality (randomized trials and larger studies), novel findings, and clinical applicability. Of 2995 articles retrieved, 107 were included, consisting of 23 randomized clinical trials, 18 cohort studies, 17 cross-sectional studies, 26 narrative reviews, 8 meta-analyses, and 15 evidence-based guidelines.

Discussion

Epidemiology

Uveitis may occur at any age (Table 1), but presents most frequently (60-80% of cases) in young and middle-aged adults (aged 20-50 years).[1,18,21] Uveitis is more common in females than males (57% of cases are among women),[22] particularly in patients with multiple sclerosis (75% female), juvenile idiopathic arthritis (50-80% female), and sarcoidosis (55-64% female).[23] However, HLA-B27-associated uveitis is more common in men (male-to-female ratio of 1.5:1). In the US and Europe, 37-49% of uveitis cases are associated with systemic disease such as axial spondyloarthritis.[5-7,11-13,18]

Among patients with uveitis who are evaluated for associated conditions, 11-21% are caused by infection in high-income countries, versus up to 50% in low- and middle-income countries.[1,8] Toxoplasmosis (5-7%) and herpetic (5-15%) uveitis are the most common infectious causes of uveitis in high-income countries,[3,4,6] with TB (8-13%)- and HIV (10-14%)-related uveitis more prevalent in low- and middle-income countries.[9,10,24,25] In Japan, Vogt-Koyanagi-Harada disease, an autoimmune disease that affects melanin-rich tissues, accounts for a higher proportion of uveitis cases (Table 1).[26,27] The most common form of uveitis in Turkey is Behçet disease (30%), a chronic, autoimmune multisystem inflammatory disorder associated with HLA-B51.[28] When compared with other regions of the world, sarcoidosis uveitis is more frequent in Europe and the US (8-10%).[29,30]

We summarize epidemiologic data in Table 1.[3,9,24,26-36]

Classification and Etiology

The Standardized Uveitis Nomenclature classified uveitis anatomically into 4 types: ‘anterior’ (inflammation in the iris and ciliary body), ‘intermediate’ (pars plana and peripheral retina), ‘posterior’ (retina and/or choroid), or ‘panuveitis’ (all areas) (Figure 1).[8] In the US and Europe, anterior uveitis is most common (41-60%), followed by posterior (17-23%), intermediate (9-15%), and panuveitis (7-32%).[5,6,11,19,30] In countries with a lower prevalence of HLA-B27, such as Japan, the most common cause is panuveitis (45.6%), followed by anterior (37.8%), posterior (12.5%) and intermediate uveitis (3%).[37] Anterior uveitis is frequently unilateral (53% of cases), while intermediate, posterior and panuveitis are typically bilateral (79%, 57% and 75% of cases, respectively).[38]

Anterior uveitis is associated with systemic diseases such as axial spondyloarthritis (15-50%) and tuberculosis (1-13%)(Table 1).[39,40] Intermediate uveitis is associated with multiple sclerosis (1-5%).[26,28,29,41] Causes of posterior uveitis include toxoplasmosis (17-50%) and sarcoidosis (1-9%).[18,26,28,29] Panuveitis is associated with toxoplasmosis (1-8%), and sarcoidosis (5-29%).[18,26,28,29] The International Uveitis Study Group provided a clinical classification of uveitis (Table 1).[42,43]

Pathophysiology

The healthy eye possesses immune privilege, allowing it to suppress immune responses against endogenous (e.g., S-antigen; a protein stopping excess sensing of light) and exogenous (e.g., bacterial proteins) antigens. This immune privilege is maintained by the blood-retina barrier, cellular mechanisms including regulatory T cells, and cytokine mechanisms, including TGFb and IL-10. Non-infectious uveitis is hypothesized to result from reduced immune tolerance to retinal proteins, leading to inflammation.[44,45] In infectious uveitis, the infectious organism breaches the blood-retina barrier, and may contain proteins resembling retinal proteins (a process called antigenic mimicry), exacerbating the inflammatory response (Figure 2). The prevailing theory is that infectious uveitis begins with pathogen-derived antigen presentation, while non-infectious uveitis begins with ocular autoantigen presentation - both involving MHC class II molecules activating naive T-cells. Naïve CD4+ T-cells differentiate into TH1 and TH17 subsets upon activation and migrate to the retina. These T-cells release pro-inflammatory cytokines (e.g., IFNγ, IL-2, IL-17), triggering a cytokine cascade that recruits immune cells such as macrophages and neutrophils, leading to chorioretinitis, vasculitis and edema.[45]

Clinical Presentation

Patients with anterior uveitis typically present with eye pain (sharp and worsened by bright light or reading) and perilimbal redness (Fig. 3A). Up to 50% of patients with anterior uveitis have vision loss, defined as visual acuity letter score less than 61 in one study.[46] In this manuscript, we use the Early Treatment Diabetic Retinopathy Study (ETDRS) method to determine visual acuity, where a score of 85 equals 20/20 on the Snellen chart or LogMAR value of 0. In intermediate uveitis, patients report painless floaters and blurred vision.[41] Patients with posterior uveitis may present with vision loss if widespread or involving the macula (Fig. 1C), but can be asymptomatic with peripheral retina involvement. Panuveitis manifests with symptoms from all 3 uveal regions. Patients with endophthalmitis, an infectious panuveitis, may present with sepsis (e.g. fever, hypotension) with eye pain and vision loss.

Assessment and Diagnosis

Patients with suspected uveitis should be referred to an ophthalmologist for diagnosis and treatment. Urgent same-day referral is necessary for vision loss or distortion, especially with eye pain and redness. Patients with visual symptoms and systemic illness (e.g., fever, hypotension) should be referred to the emergency department for evaluation and treatment due to the risk of vision-threatening endophthalmitis and potentially life-threatening sepsis. Some signs of uveitis, like posterior synechiae (iris-lens adhesions causing a distorted pupil), can be identified without specialized equipment. Direct ophthalmoscopy can identify retinitis, choroiditis, and optic disc swelling. Definitive diagnosis requires a slit lamp to examine the anterior segment of the eye and a handheld lens for the fundus (i.e. indirect ophthalmoscopy). Signs of uveitis on slit lamp include a cellular infiltrate in the anterior chamber, and keratic precipitates (cell deposits cells on the posterior cornea) (Fig. 1A-B). In intermediate uveitis, cellular infiltrate appears in the vitreous humor, and choroidal and/or retinal inflammation in the ocular fundus (Figure 1). Figure 3 provides a diagnostic algorithm for suspected uveitis.

Patients who initially present with unilateral anterior uveitis without signs or risk factors for infection or systemic symptoms indicating autoimmune disease (e.g. joint pain and skin rash) do not require additional testing. Patients with recurrent or bilateral anterior uveitis, intermediate uveitis, posterior uveitis, or panuveitis should be tested for infection (e.g., syphilis) and systemic disease (eg, sarcoidosis). Figures 3 and 4 detail tests for systemic conditions. Aqueous humor and/or vitreous sampling (for microscopy and culture) should be performed if infection is suspected. Because infectious organisms are identified in only 22–32% of cases, a negative result does not exclude infection.[47] Additional systemic testing, particularly for syphilis or tuberculosis, is needed.

There is no international consensus on the best diagnostic approach for uveitis. Testing varies by regional infection prevalence, comorbidities, immunocompromise, and clinical presentation. Patients who are immunocompromised, especially those with HIV, require comprehensive infectious screening for both HIV-related and opportunistic infections, including cytomegalovirus and candida.

Treatment

Treatment is determined by the patient's anatomical uveitis subtype, infectious exposures, age, comorbidities, country of origin, signs of infection and sight-threatening features of uveitis (such as severe vitritis, macular edema, retinochoroiditis, and forms of uveitis carrying high risk of visual loss e.g. Behçet disease). The goal of therapy is to reduce inflammation in the uvea, thereby lowering the risk of vision loss.

Non-Infectious Anterior Uveitis

Topical Corticosteroids

For non-infectious anterior uveitis, prednisolone acetate is the most commonly used first-line topical corticosteroid,[48] which is administered initially as hourly steroid drops during waking hours in the affected eye for 7 days, followed by a taper. Tapering typically reduces the dose by one drop weekly (6 times daily, 5 times daily, etc.) until discontinuation, individualized based on clinical response. A randomized trial of 78 patients with acute, chronic and recurrent anterior uveitis compared the effectiveness of prednisolone acetate 1% and rimexolone 1% ophthalmic suspensions in reducing anterior chamber inflammatory cells, a marker of uveitis, as measured by slit-lamp examination at 28 days. Mean anterior chamber cell scores decreased from 1.79 to 0.13 ($P<0.05$) with prednisolone and from 1.81 to 0.14 ($P<0.05$) with rimexolone, both treatments achieving clinical meaningful change. The difference between the two treatments was not statistically significant.[49]

Ocular Corticosteroids

Localized corticosteroid injections are used as second-line therapy for non-infectious anterior uveitis if topical corticosteroids are ineffective and when systemic treatment (such as systemic corticosteroids) is unsuitable or not tolerated.[50] However, in cases of severe uveitis, systemic corticosteroids are favored. Options include short-acting steroid injections around the eye (sub-Tenon's space overlying the sclera or orbital floor; 1-2 months duration, such as triamcinolone acetonide), intermediate-

acting steroid implants into the vitreous (3-6 months duration, such as dexamethasone), and longer-acting steroid implants into the vitreous (36 months duration, such as fluocinolone acetonide). A 6-month multicenter RCT (N=192) of patients with uveitic macular edema reported significantly reduced macular thickness at 8 weeks with use of intravitreal triamcinolone implants (39%) and dexamethasone implants (46%) at 8 weeks compared with periocular triamcinolone implants (23%, p<0.0001 vs. baseline for all comparisons).[51] A recent RCT (n=160) reported that suprachoroidal triamcinolone improved visual acuity by 15 or more letters in 47% of patients at 4 weeks compared to 16% with placebo (p<0.001).[52]

Systemic Corticosteroids

Systemic corticosteroids are recommended for severe non-infectious anterior uveitis that does not improve or worsens with topical or regional corticosteroids.[53,54] Treatment typically begins with high-dose oral prednisone at 1 mg/kg/day, up to 60-80 mg daily, tapering over 4-10 months.[53]

Complications associated with use of Ocular and Systemic Corticosteroids

Ocular hypertension, glaucoma, and cataracts can develop from prolonged topical, periocular, intravitreal implant and systemic corticosteroid use. Up to 18-24% of patients treated with steroids may require cataract or glaucoma surgery.[48,55,56]Complication frequency depends on corticosteroid type, administration route, application frequency, and treatment duration. Among 192 patients with uveitic macular edema, the intravitreal dexamethasone implant had a cumulative risk of ocular hypertension at 24 weeks of 41% (95%CI: 26-53%), comparable to intravitreal triamcinolone at 30% (95%CI: 17-40%;P=0.37), but significantly higher than periocular triamcinolone at 20% (95%CI: 9-29%,P=0.007).[51] In a randomized trial of 160 patients with uveitic macular edema, suprachoroidal triamcinolone and sham treatment had similar frequency of ocular hypertension(11.5% vs 15.6%) and cataracts (7.3% vs 6.3%),with no significant differences.[52]

Non-Infectious Posterior Uveitis

While mild intermediate uveitis may be monitored without initial treatment, patients with moderate to severe intermediate uveitis, posterior uveitis, and panuveitis are at high risk for sight-threatening complications and require systemic and/or intravitreal corticosteroids and immunosuppressive agents.

Systemic Corticosteroids

Systemic corticosteroids are typically used to achieve remission in patients with non-infectious posterior uveitis, regardless of the cause (Figure 3). For vision-threatening conditions, such as Behçet disease or Vogt-Koyanagi-Harada syndrome, high-dose intravenous methylprednisolone (1 gram, once daily for 3 days) may be prescribed.[53] Long-term use of systemic corticosteroids, especially at doses exceeding 7.5 mg daily of prednisone, is associated with risks including hyperglycemia and osteoporosis. The SITE retrospective cohort study (N=9,263) examined treatment outcomes for ocular inflammation. Among 47 patients with non-infectious uveitis, 57% (95%CI: 33-83%) attained complete remission of inflammation within 1 month after receiving intravenous methylprednisolone (500-1000 mg, once daily up to 3 days), followed by tapering oral

prednisone over 4-10 months.[53,57] Treatment aims for rapid remission, verified by resolution of uveitis findings on eye examination and imaging (eFigure 1).[53] An RCT that included 255 patients with non-infectious intermediate, posterior, and panuveitis reported that those treated with systemic therapy (corticosteroids and/or disease-modifying antirheumatic drugs [DMARDs] and/or biologics) had clinically meaningful improvements in visual acuity over 7 years, gaining 7.2 letters compared with those receiving fluocinolone acetonide implants (95%CI: 2.1-12; p<0.01).[58-60]

Disease-modifying antirheumatic drugs

Evidence-based guidelines recommend systemic corticosteroids in combination with DMARDs as first-line therapy for non-infectious posterior uveitis to control severe/persistent inflammation and decrease the risk of complications (Box 1).[61,62] DMARDs alone can be used for patients with contraindications to or intolerance of corticosteroids. Dosing, adverse effects, contraindications, and effect of DMARDs and biologics are listed in Table 2.

In the SITE cohort of patients with non-infectious uveitis (N=168), 52.1% (95%CI: 38.6–67.1%) of patients with posterior or pan-uveitis and 74.9% (95%CI: 56.1–90.3%) of patients with intermediate uveitis receiving weekly methotrexate achieved control of inflammation, defined as complete suppression of inflammation on examination sustained for 28 days or more, at 12 months.[63] Additionally, 40% to 50% of patients taking methotrexate maintained control of inflammation with a prednisone equivalent dose of 10mg or less daily. Approximately 15% of patients discontinued methotrexate due to lack of efficacy and another 15% discontinued it due to adverse effects such as gastrointestinal upset or bone marrow suppression.[63]

In the SITE study, among 145 patients with non-infectious uveitis, treatment with mycophenolate mofetil was associated with control of inflammation, defined as no inflammatory activity on ocular examination, at 12 months in 70.9% (95%CI: 57.1-83.5%) of patients with posterior or pan-uveitis and 76.7% (95%CI: 49.1-95.6%) of patients with intermediate uveitis.[64] An open-label, multicenter RCT of 41 patients with non-infectious intermediate uveitis reported a lower relapse rate over 15 months with use of prednisone plus mycophenolate mofetil compared with prednisone alone (40.9% vs 78.9%, P<0.05).[65]

In an RCT of patients with Behçet's syndrome (N=73), among those without eye involvement at the start of the study (N=25), 8.3% in the azathioprine group developed uveitis, compared with 61.5% in the placebo group (P<0.01).[66] Additionally, among patients with Behçet's syndrome who already had eye involvement (N=48), azathioprine reduced recurrent uveitis episodes (4% vs 65.2%, P<0.001). In the SITE cohort of patients with non-infectious uveitis (N=91), azathioprine was associated with complete control of inflammation on ocular examination at 6 months in 69% (95%CI: 41-93%) of patients with intermediate uveitis, 44% (95%CI: 28-64%) of patients with posterior or pan-uveitis, and 24% (95%CI: 10-52%) of those with anterior uveitis.[67]

In the SITE study of non-infectious uveitis of all etiologies (N=373), cyclosporine was associated with controlled inflammation at 1 year on ocular examination in 51.7% (95%CI: 42.6-61.6%) of patients with posterior or pan-uveitis and 51.8% (95%CI: 40.4-64.2%) of patients with intermediate uveitis.[68] In an RCT of 70 patients with Vogt-Koyanagi-Harada disease, recurrence or worsening of uveitis at 1 year was reported in 15.0% (95%CI: 3-27%) of patients receiving cyclosporine plus oral

prednisone compared with 25.0% (95%CI: 11-39%) receiving intravenous steroid pulse followed by oral prednisone.[69] The absolute risk difference between groups was -10.0% (90%CI -27.0% to 6.0%), meeting the predefined noninferiority margin of 20.0% (P=0.001 for noninferiority).

Biologics

For patients with poorly controlled non-infectious posterior uveitis despite treatment with DMARDs, biologic therapy is second-line treatment,[61,62] with adalimumab having the strongest evidence of effectiveness.[70-77]

Adalimumab was approved by the US Food and Drug Administration (FDA) in 2016 to treat adults with non-infectious uveitis (Table 2).[70,71] The VISUAL placebo-controlled RCTs compared adalimumab's efficacy in patients with non-infectious posterior uveitis.[70,71] In the VISUAL I trial (N=217 with active non-infectious intermediate uveitis, posterior uveitis, or panuveitis despite prednisone for >2 weeks), time to treatment failure (defined by new lesions, persistent inflammation, or vision loss ≥15 letters after week 6) was 24 weeks with adalimumab vs 13 weeks with placebo (HR 0.50; 95%CI, 0.36-0.70).[70] However, adalimumab was associated with higher rates of adverse events such as reduced visual acuity and fatigue (1052.4 vs 971.7 per 100 person-years) and serious adverse events such as pneumonia and demyelination (28.8 vs 13.6 per 100 person-years) compared with placebo.[70] In the VISUAL II trial (N=226 with inactive non-infectious intermediate, posterior, or panuveitis controlled by 10-35 mg/day of prednisone), time to treatment failure was longer with adalimumab (median not reached [>18 months] vs 8.3 months with placebo; HR 0.57; 95%CI, 0.39-0.84).[71]

Golimumab, a biologic agent that blocks tumor necrosis factor alpha (TNF-a), was FDA-approved for treatment of adults with axial spondyloarthritis. A multicenter prospective study (N=93) of patients with axial spondyloarthritis, who often experience anterior uveitis, evaluated its efficacy.[74] Comparing pre- and post-treatment periods, golimumab was associated with a reduction in anterior uveitis episodes from 11.1 to 2.2 per 100 person-years (rate-ratio 0.20, 95%CI 0.04-0.91).[74]

Certolizumab pegol, a monoclonal antibody to TNF-a, was FDA-approved for treatment of adults with axial spondyloarthritis, and was evaluated in an open-label trial (N = 115) of patients with axial spondyloarthritis and recurrent uveitis.[75] In the 2-year pre-treatment period, all patients experienced more than 1 uveitis episode, with 59.6% experiencing more than 2 episodes of uveitis. Following 2 years of certolizumab treatment, 11.2% of patients had more than 2 episodes of uveitis (P<0.001; pre- vs post-treatment).[75]

Infectious Uveitis

For patients with infectious uveitis, the primary goal is treating the underlying infection with systemic and/or local antimicrobials, guided by evidence-based guidelines. Treatment with concomitant corticosteroids depends on clinical findings (e.g., vision-threatening chorioretinitis) and clinician judgment (considering disease severity, vision loss risk, corticosteroid-related risks). Corticosteroids should not be used alone in viral retinitis or toxoplasmosis because they suppress immune function without controlling pathogen replication, risking disease progression.[78]

Infectious Panuveitis (Endophthalmitis)

Treatment of infectious panuveitis (also termed endophthalmitis) varies based on whether the source of infection is exogenous (e.g.,surgery) or endogenous (e.g.,endocarditis). Exogenous cases require intravitreal antimicrobials, while endogenous cases should be treated with systemic antimicrobials plus targeted infection management (e.g., abscess drainage, valve replacement). Empiric broad-spectrum antimicrobials should be initiated, and subsequently tailored based on microbiological results. A retrospective study of 278 US patients with endogenous and exogenous endophthalmitis reported 78.5% had gram-positive organisms (100% sensitive to vancomycin, 63.6% to ceftazidime) and 11.8% had gram-negative organisms (94.2% sensitive to ciprofloxacin, 80.9% to amikacin); the remainder were fungi.[79]

Tuberculosis

Uveitis may be caused by TB infection within the eye or as an inflammatory reaction to TB infection elsewhere in the body. The decision to start antitubercular therapy for uveitis should be based on the likelihood of active tuberculosis infection, as indicated by immunological (e.g. IGRA or Mantoux) and radiological findings and the population-based prevalence of tuberculosis.[80] The World Health Organization (WHO) recommends a 6-month regimen: isoniazid/rifampicin/pyrazinamide/ethambutol for 2 months, followed by isoniazid/rifampicin for 4 months, achieving 85% success for drug-susceptible TB.[80-82] In a meta-analysis of 49 retrospective studies with 4017 participants with tubercular uveitis, complete resolution of inflammation on ocular examination and imaging was achieved in 83% (95%CI: 77-89%) of 1,812 patients, and visual acuity improved in 65% (95%CI: 51-78%) of 542 patients.[81]

Syphilis

Syphilitic uveitis can present at any stage but is most common in secondary and late latent (after primary symptoms resolved).[83] For early syphilis, the WHO and CDC recommend a single 2.4-million-unit intramuscular benzathine penicillin dose.[84,85] For ocular syphilis, the CDC recommends daily intravenous aqueous crystalline penicillin (10-14 days)[85] and WHO recommends weekly intramuscular benzathine penicillin (3 weeks).[84] A meta-analysis of 32 retrospective studies (670 patients) with ocular syphilis reported treatment success for improving visual acuity of 91% (95%CI 84–97%) with antibacterial agents alone (penicillin, ceftriaxone, tetracycline or doxycycline), and 95% (95%CI 91–98%) with antibacterial agents with systemic corticosteroids.[86]

Systemic corticosteroids (e.g.,oral prednisone, 60mg/day for 1 week then tapered) are typically started 48 hours before antibiotics to mitigate the inflammatory response, although controlled studies are lacking.

HSV and VZV

There is a paucity of high-quality evidence regarding management of viral uveitis. The Infectious Uveitis Treatment Algorithm Network expert consensus (87% agreement) recommends administration of both antiviral and anti-inflammatory treatments for HSV and VZV anterior uveitis based on clinical appearance alone, without confirmatory testing. Experts advise against using topical corticosteroids alone for viral uveitis.[87,88] Antiviral treatment for HSV and VZV anterior uveitis consists of acyclovir or its prodrug valacyclovir.[89] These medications can also be used as preventive therapy, to help reduce future recurrences, which were experienced by 44.9% of patients within 10 years.[90] Although duration of prophylactic therapy should be individualized based on

disease severity and recurrence history, long-term prophylaxis with oral acyclovir (400-800 mg twice daily) or valacyclovir (500 mg once daily) can be used and typically is continued for one year after the last episode of inflammation. The treatment of viral posterior uveitis (less common than viral anterior uveitis) combines systemic antiviral therapy with intravitreal antiviral therapy.[91]

Cytomegalovirus

No RCTs have examined treatments for CMV-related uveitis. A systematic review of retrospective and open-label studies of 106 patients with CMV anterior uveitis reported inflammation resolution among 90% of patients (95%CI: 74–100%) treated with topical ganciclovir gel and 95% (95%CI: 88–100%) with oral valganciclovir.[92] CMV posterior uveitis, which occurs in patients who are immunocompromised, may be treated with intravenous ganciclovir or oral valganciclovir. Patients with CMV posterior uveitis and HIV should also receive anti-retroviral medications.[93,94] Foscarnet is used for CMV uveitis resistant to ganciclovir or valganciclovir.

Candidiasis

Current treatments for ocular candidiasis have not been evaluated by high-quality RCTs.[95] A trial comparing amphotericin B and fluconazole in 206 patients with candidemia reported no significant difference in symptom resolution and fungemia—79% for amphotericin B and 70% for fluconazole (P=0.22).[96] The Infectious Diseases Society of America (IDSA) recommends systemic antifungal therapy for candida chorioretinitis without vitritis, with either fluconazole or voriconazole for susceptible strains of candida, and amphotericin B for resistant strains.[97] For patients with macular involvement or vitritis, intravitreal amphotericin B is also recommended.[97] For patients with vitritis, vitrectomy may be considered to reduce the fungal load and excise vitreous abscesses.

Aspergillosis

For patients with uveitis due to aspergillus, IDSA recommends oral or intravenous voriconazole with either intravitreal voriconazole or intravitreal amphotericin B, along with vitrectomy.[98]

Toxoplasmosis

Systemic therapy (pyrimethamine-sulfadiazine or trimethoprim-sulfamethoxazole) is first-line treatment for ocular toxoplasmosis.[99] A systematic review of 3 RCTs (N = 227) comparing antibiotics with placebo for toxoplasma chorioretinitis reported recurrence rates over 12-20 months of 18.9% in the placebo group vs 4.5% in the antibiotic group (P < 0.001).[100] A systematic review of 2 RCTs (N=86) comparing different systemic antibiotic regimens (trimethoprim-sulfamethoxazole vs. pyrimethamine-sulfadiazine or azithromycin) reported that no antibiotic regimen was superior to others in reducing eye inflammation on ocular examination (62.8% vs. 62.8%; RR, 1.08; 95%CI, 0.59-1.98).[101]

Complications of uveitis

Severe and chronic inflammation due to uveitis may cause vision-threatening complications such as cataracts (18-49%), glaucoma (7-56%), and macular edema (8-10%), which can develop despite appropriate treatment(Fig. 1).[55,56,102] Elevated

intraocular pressure (i.e. ocular hypertension) without nerve damage precedes glaucoma with optic nerve damage causing progressive vision loss. Macular edema impairs detailed central vision.

Prognosis

Infectious uveitis

Long-term outcome data for infectious uveitis are limited. In a US study of 77 patients with infectious uveitis, (most commonly, herpetic anterior uveitis and toxoplasmosis),[103] 55.8% of patients had visual acuity better than 70 letters at presentation, decreasing to 50.6% after 5 years despite treatment. In 66 patients with ocular syphilis treated with intravenous penicillin/doxycycline/ceftriaxone, 71.8% had improved visual acuity, with a mean 30-letter gain over 10 months.[104] In patients with ocular toxoplasmosis (N=92), 21% of affected eyes had vision below 35 letters at final follow-up, with a 33.9% recurrence rate at 3 years post-antibiotics.[105]

Non-infectious uveitis

The 7-year MUST cohort of posterior uveitis (N=177) reported that visual acuity declined annually, more in eyes with macular edema (-1.82 vs -0.72 letters/year; P<0.01).[106] The VISUAL III study (N=214 with noninfectious intermediate, posterior, or panuveitis) reported that adalimumab 40 mg subcutaneous every other week increased quiescence rates—defined as the absence of active eye inflammation—from 34% to 85% over three years.[107]

Limitations

This review has limitations. First, some publications may have been missed. Second, the review process lacked a systematic evaluation of evidence quality. Third, the review is limited by varying study eligibility criteria, outcome measures, and follow-up lengths, as well as lack of long-term data on the effectiveness of newer treatments.

Conclusion

Uveitis is characterized by inflammation of the uvea and primarily affects adults aged 20 to 50 years. For non-infectious anterior uveitis, corticosteroid eyedrops are first-line treatment. For posterior non-infectious uveitis, DMARDs are first-line therapy; biologics such as adalimumab are second-line treatment for patients with inflammation refractory to treatment. Uveitis caused by systemic infection should be treated with antimicrobials, and local or systemic steroids may be used depending on the severity of uveitis and the specific microorganism.

Acknowledgements

Dr. Panayiotis Maghsoudlou has received honoraria from Bayer. Dr. Simon Epps has received honoraria from Alimera and GlaxoSmithKline. Prof. Andrew Dick has received research grants from Janssen Pharmaceutical, Novartis and the NIHR Biomedical Research Centre, consulting fees or honoraria from Affybody, Revolobio, Gilead, and Alimera and is a co-founder of Cirrus Therapeutics.

Figure Legends

Figure 1 Clinical Features of Uveitis.

(A) Illustrates anterior uveitis characteristics, including ciliary injection. The iris may develop adhesions either anteriorly to the structures of the anterior chamber angle and/or corneal posterior surface (anterior synechiae) or posteriorly to the lens (posterior synechiae), causing pupil distortion. Both forms of synechiae increase the risk of raised intraocular pressure and glaucoma. A hypopyon may be present, characterized by an accumulation of white blood cells in the inferior portion of the anterior chamber (the fluid-filled space between the cornea and iris), appearing as a whitish or yellowish layer at the bottom of the anterior chamber. (B) Depicts anterior chamber cells, flare, and KPs associated with anterior uveitis. In chronic disease, the cornea may develop a progressive calcific opacification usually beginning at the 3 and 9 o'clock positions then spreading centrally and referred to as band keratopathy. (C) Shows features of posterior uveitis, split into acute (top half) and chronic (bottom half). Acutely optic disc swelling (papillitis) with its attendant risk of optic nerve dysfunction may be seen as a complication of uveitic inflammatory activity directly or secondary to hypotony. Occlusive vasculitis, vascular sheathing, hemorrhages, and focal chorioretinal spots can also present with different types of uveitis. The lower half of this figure demonstrates posterior segment complications, including glaucomatous optic neuropathy, which is associated with poorer long-term visual outcomes. Neovascular responses, particularly in the form of choroidal neovascular macular membranes may develop in the chronic phase. Epiretinal membrane formation on the inner surface of the macula can cause visual distortion. A variety of disease mechanisms may result in retinal detachment. Chorioretinal scarring and subretinal fibrosis may cause severe visual impairment especially if the macula is affected and has a poor visual prognosis with limited treatment options.[1,90,91] Clinical features suggestive of infection include uveitis with corneal disease (e.g. corneal swelling), iris atrophy, or increased intraocular pressure (herpes), hypopyon with vitritis (endophthalmitis), string-of-pearls appearance to vitreous (fungal), occlusive retinal vasculitis (TB), placoid chorioretinopathy (syphilis), and chorioretinitis adjacent to a pigmented chorioretinal scar (toxoplasmosis). These sketches are preliminary and will be refined by the in-house professional medical illustrators, as agreed with the editorial team; KPs: keratic precipitates.

Figure 2 Uveitis Pathogenesis

The retina's immune privilege relies on the blood-retina barrier, which shields ocular tissue proteins from the systemic immune system. This protective mechanism can be compromised, leading to autoimmune reactions. Within the retina, regulatory T cells (Tregs) marked by CD4+, CD25+, and FoxP3+ identifiers contribute to immune tolerance by emitting neuropeptides and anti-inflammatory cytokines. These Tregs can suppress other T cells that escape the thymus without proper immune tolerance, producing cytokines like IL-10, TGFß, and IL-35 to reduce inflammation. Furthermore, retinal pigment epithelium and retinal cells express certain proteins on their surfaces that deactivate lymphocytes, thereby regulating ocular inflammation. Uveitis often begins when immune privilege breaks down, leading to an intolerance of retinal proteins such as S-antigen. Retinal antigens can reach peripheral tissues via ocular trauma or mimicry mechanisms and interact with self-reactive cells, which have escaped from central and peripheral tolerance. Disease onset is typically associated with MHC class II molecule-mediated presentation of autoantigens or cross-reactive foreign peptides to naive T-cells, disrupting self-tolerance. Activated CD4+ T-cells differentiate into CD4+ TH1 and TH17 cells that migrate to the affected tissue, recruiting inflammatory cells and producing tissue damage. TH1 cells, release cytokines like IFNγ and IL-2, while TH17 cells produce IL17 and IL23. These facilitate the recruitment activation of downstream cytokine release and innate inflammatory response, for example, IL-6 and TNFα, granzyme B, which in turn can lead to vasculitis and edema[21,22]. These sketches are preliminary and will be refined by the in-house professional medical illustrators, as agreed with the editorial team.

Figure 3 Algorithm for the initial investigation and management of patients with possible uveitis

The figure provides a detailed flowchart for the management of patients with suspected uveitis, categorized by the type of uveitis. Patients with possible uveitis will develop symptoms dependent on the anatomical location of the inflammation and should be

referred to an ophthalmologist for assessment. If the patient is acutely ill, or experiencing vision loss this should be an urgent referral. The management of anterior uveitis varies depending on whether it is the first episode or recurrent. If it is the first episode with no signs suggestive of infection and no risk factors, treatment proceeds without investigation. However, if the uveitis is recurrent or if risk factors are present, blood tests and a chest X-ray are recommended. Anterior chamber sampling is considered if there are signs of viral infection, such as corneal edema, elevated intraocular pressure, or iris atrophy. Treatment involves using oral antivirals and low-frequency topical steroids if there are signs of viral infection, or high-frequency topical steroids if no infection is suspected while awaiting results. For posterior segment uveitis, which includes intermediate, posterior, and panuveitis, the investigation involves blood tests and imaging for all cases. Anterior chamber and vitreous sampling are recommended if signs of infection are present. Treatment varies based on whether the case is vision-threatening. For non-vision-threatening cases, if signs of infection are present, treatment with broad-spectrum antibiotics or antivirals is initiated while awaiting results. For all other cases, infection is excluded using blood tests and imaging before inducing remission with high-dose local and systemic corticosteroids. Early systemic immunosuppression is considered to reduce corticosteroid load and associated side effects. For acutely unwell or vision-threatening cases, a comprehensive investigation with blood tests, imaging, and ocular sampling is conducted. Treatment includes broad-spectrum antibiotics or antivirals while awaiting results, followed by high-dose local and systemic corticosteroids if infection is excluded. Joint management with internists is considered for acutely unwell patients.

*Bloods to include ANA (Juvenile Idiopathic Arthritis), ACE/lysozyme (sarcoidosis), HLA-B27, Renal panel (creatinine and beta-2 macroglobulin levels for Tubulointerstitial Nephritis and Uveitis [TINU] Syndrome). Urinalysis to assess for proteinuria in TINU and hematuria in IgA nephropathy

** Bloods to include FBC, Renal panel, Syphilis serology, ACE/lysozyme, interferon gamma release assay (IGRA; for TB), ANA, HLA-B27

† Bloods to include FBC, Renal panel, Syphilis serology, ACE/lysozyme, interferon gamma release assay (IGRA; for TB),

Figure 4 Clinical Approach to Uveitis: Linking Suggestive Features, Etiologies, and Diagnostic Tests

Diagnostic approach to uveitis based on clinical features, showing key signs and symptoms that suggest specific conditions. The figure is organized into major presenting features (left), leading to suspected conditions (center), required confirmatory tests (center-right), and epidemiological information including prevalence and anatomical patterns (right). Common presentations include joint symptoms, neurological manifestations, viral prodromes, endemic exposures, and immunosuppression. Each path provides relevant diagnostic tests and disease-specific details to guide clinical decision-making.

eFigure 1 Imaging modalities used in the diagnosis and monitoring of uveitis.

Non-invasive techniques include fundus photography, optical coherence tomography (OCT), ultra-widefield retinal photography, fundus autofluorescence, and OCT angiography, which are routinely used. Invasive methods, used in select cases of intermediate, posterior, or panuveitis, include fluorescein angiography for identifying retinal vascular inflammation and leakage; indocyanine green angiography for detecting choroidal inflammation; and B-scan ultrasonography for evaluating the posterior segment when fundal view is obscured or diagnosing posterior scleritis, although it has low sensitivity for discriminating disease.

Domain	Characteristics
Prevalence	38 - 714 per 100,000 people globally
Incidence	17 - 52 per 100,000 people globally
Age Distribution	Most common in young and middle-aged adults (20-50 years), comprising 60-80% of cases. Can present at any age.
Gender Distribution	Overall, slightly more common in females. Female preponderance in multiple sclerosis (75% female), juvenile idiopathic arthritis (50-80% female), and sarcoidosis (55-64% female). HLA-B27 associated-uveitis more common in men (male: female ratio up to 1.5:1).
Laterality	Unilateral uveitis is at least as common as bilateral uveitis in specialist and non-specialist clinics.
Types of Uveitis	Classified anatomically as: Anterior uveitis (41-60%), Intermediate uveitis (9-15%), Posterior uveitis (17-23%), Panuveitis (7-32%) Specific diseases target distinct locations, with axial spondyloarthritis predominantly anterior (90.5%) and multiple sclerosis typically intermediate (80%)..
Symptoms	Anterior uveitis: Pain, redness, photophobia Intermediate uveitis: Increased floaters, painless, blurred vision Posterior uveitis: Blurred vision, visual distortion, or asymptomatic Panuveitis: Pain, redness, photophobia, blurred vision
Etiology	**Infectious (11-50% of cases):** *Endophthalmitis* (an infection-driven inflammation of the entire eye): Endogenous (from hematogenous spread) or exogenous (following surgery or trauma). *Viral* Herpes simplex/Herpes zoster (5-15%), Cytomegalovirus (1-5%), HIV (1-14%, rest of viral causes listed are rare), Chikungunya, Zika, HTLV-1, West Nile, measles, mumps, rubella, dengue, Ebola. *Bacterial* Tuberculosis (1-13%), syphilis (1-4%), lyme (<1%, rest of bacterial causes rare), leprosy, bartonella, leptospirosis, Whipple's disease (T. whipplei). *Parasitic* Toxoplasmosis (5-7%), toxocariasis (<1%, rest of parasitic causes rare), onchocerciasis, cysticercosis. *Fungal* Candidiasis (<1%, rest of fungal causes rare), aspergillosis, histoplasmosis, Pneumocystis jirovevecii, cryptococcus. **Non-infectious(52-79%):** *With known systemic association* Sarcoidosis, Behçet disease, Vogt-Koyanagi-Harada syndrome*, Juvenile Idiopathic Arthritis, Tubulointerstitial Nephritis with Uveitis, IgA nephropathy, Multiple Sclerosis, HLA-B27-associated (axial spondyloarthritis, reactive arthritis, psoriatic arthritis, inflammatory bowel disease). *With no known systemic association* Fuch's heterochromic uveitis, Posner-Schlossman syndrome, Multifocal Choroiditis with Panuveitis, Punctate Inner Choroidopathy, Acute Posterior Multifocal Placoid Pigment Epitheliopathy, Serpiginous Choroidopathy, Birdshot Uveitis, Acute Zonal Occult Outer Retinopathy, Multiple Evanescent White Dot Syndrome, Sympathetic Ophthalmia, Idiopathic Retinal Vasculitis and Neuroretinitis syndrome. **Idiopathic (27-51%):** No identifiable cause despite full workup. **Trauma (5-20%)** **Masquerade syndromes (1-5%)** *Neoplastic* *Non-neoplastic* Ocular ischemia, Schwartz-Matsuo syndrome (anterior uveitis, raised intraocular pressure and retinal detachment) **Medication-induced (0.5%)** Immune checkpoint inhibitors, bisphosphonates, latanoprost, rifabutin, fluoroquinolones, sulfonamides, topiramate

Geographic Distribution	Low- and middle-income countries: infections 50% (TB most common: 8-10%). High-income countries: infections 11-21% (herpes 10%, toxoplasmosis 7%) Sarcoidosis uveitis more common in US and Europe (3-7% of all cases) Behçet uveitis more common in Turkey and along historical Silk Road regions (Japan, China, Iran, Iraq, Korea, Saudi Arabia; 25-32% of all cases) Vogt-Koyanagi-Harada disease more common in Japan, Korea, China, and India (5-8% of all cases)

Table 1 Major epidemiologic and clinical characteristics of uveitis

*Footnote: Vogt-Koyanagi-Harada syndrome is a rare autoimmune disorder against melanocytes, causing bilateral panuveitis with retinal detachments, along with neurological (meningism), auditory (tinnitus) and skin (vitiligo, alopecia, poliosis [a white streak in the hair]) signs.

Class	Category	Drug	Population	Design	Effect Size	Adult Dose & Administration	Adverse Effects	Monitoring
Disease Modifying Antirheumatic Drugs	Antimetabolites	Methotrexate	168 patients with non-infectious uveitis	Retrospective cohort study	Control of inflammation at 12 months: Anterior uveitis: 67.2% (95% CI: 56.7–77.3) Intermediate uveitis: 74.9% (95% CI: 56.1–90.3) Posterior/Panuveitis: 52.1% (95% CI: 38.6–67.1) Patients stopping medication for any reason (32%), side-effects (18.1%), ineffectiveness (15.4%)	7.5–25 mg/week	Embryofetal toxicity, gastrointestinal reaction (10%), bone marrow suppression (2%), hepatoxicity (15%)	Complete I GFR, Liver
		Mycophenolate Mofetil	145 patients with non-infectious uveitis	Retrospective cohort study	Control of inflammation at 12 months: Anterior uveitis: 72.4% (95% CI: 52.4 – 89.2) Intermediate uveitis: 76.7% (95% CI: 49.1 – 95.6) Posterior/Panuveitis: 70.9% (95% CI: 57.1 – 83.5) Patients stopping medication for any reason (34%), side-effects (12%), ineffectiveness (9.7%)	1-2g BID	Embryofetal toxicity, gastrointestinal reaction (20%), Bone marrow suppression (2%), hepatoxicity (20%)	Complete I GFR, Liver Mycophen patients wh
			42 patients with non-infectious intermediate uveitis	RCT (prednisone & mycophenolate vs. prednisone)	Relapse rate at 15 months: 40.9% (mycophenolate) vs. 78.9%			
		Azathioprine	91 patients with non-infectious uveitis	Retrospective cohort study	Control of inflammation at 12 months: Anterior uveitis: 34.6% (95% CI: 15.2 – 66.7) Intermediate uveitis: 89.8% (95% CI: 63.6 – 99.4) Posterior/Panuveitis: 59.7% (95% CI: 40.9 – 79.3) Patients stopping medication for any reason (68%), side-effects (24%), ineffectiveness (15%)	150-200mg QD	Gastrointestinal reaction (10%), Bone marrow suppression (5%), hepatoxicity (4%), hypersensitivity syndrome (rash and arthralgia)	Complete I GFR, Liver
			73 patients with Behçet	RCT (placebo-controlled)	In patients with pre-existing uveitis: Episodes of uveitis 65.2% (placebo) vs. 4% (azathioprine) In patients with no pre-existing uveitis: Episodes of uveitis 61.5% (placebo) vs. 8.3% (azathioprine)			
	Calcineurin Inhibitors	Cyclosporine	70 patients with Vogt-Koyanagi-Harada disease	RCT (cyclosporine + oral prednisone vs. intravenous + oral prednisone)	Recurrence rate at 12 months 15.0% (95% CI: 3-27%) for combination therapy vs 25% (95% CI: 11-39%) for prednisone	1.5mg/kg BID	Nephrotoxicity (4%), hypertension (3%), hepatotoxicity (1.5%), gum hyperplasia (1%), skin cancer	Complete I GFR, Liver pressure Cyclospori for patients therapy
			373 patients with non-infectious uveitis	Retrospective cohort study	Control of inflammation at 12 months: Anterior uveitis: 54.3% (95% CI: 40 – 69.9) Intermediate uveitis: 51.8% (95% CI: 40.4 – 64.2) Posterior/Panuveitis: 51.7% (95% CI: 42.6 – 61.6) Patients stopping medication for any reason (49%), side-effects (13%), ineffectiveness (7%)			
Biologics	TNF blockers	Adalimumab	217 adults with active non-infectious posterior	RCT (placebo-controlled)	Treatment failure (new inflammatory lesions, anterior chamber or vitreous inflammation, or worsening of visual acuity) 54.5% (adalimumab) vs. 78.5% (placebo)	40mg SC every 2 weeks	Infusion reactions (20%), gastrointestinal reaction (15%), Hepatotoxicity (10%),	Complete I GFR, Liver pressure

			segment uveitis				demyelination, increased risk of malignancy and infection (including TB, HepB)	Repeat IGI symptoms Consider b symptoms disorders. Anti-adalim measured respondin
			226 adults with inactive non-infectious posterior segment uveitis	RCT (placebo-controlled)	<u>Treatment failure (new inflammatory lesions, anterior chamber or vitreous inflammation, or worsening of visual acuity):</u> 39% (adalimumab) vs. 55% (placebo)			
			114 children with active Juvenile Idiopathic Arthritis-associated uveitis	RCT (placebo-controlled)	<u>Treatment failure (persistent or worsening intraocular inflammation, lack of improvement, development or worsening of coexisting ocular conditions, or protocol deviations such as ineligible medications or prolonged suspension of the trial regimen):</u> 27% (adalimumab) vs. 60% (placebo)			
			31 children with chronic Juvenile Idiopathic Arthritis-associated uveitis	RCT (placebo-controlled)	<u>Reduction of inflammation by 30% determined by laser flare photometry, with no worsening on slit-lamp examination</u>: 56.3% (adalimumab) vs. 20% (placebo)			
		Golimumab	93 patients with axial spondyloarthritis and recurrent uveitis	Prospective study	<u>Episodes of uveitis</u> 11.1 per 100 person-years (12 months before golimumab) vs. 2.2 per 100 person-years (12 months after); 80.2% reduction	50mg SC monthly	Hepatotoxicity, bone marrow suppression, Infusion reactions (2%), hypertension (2%), demyelination, increased risk of malignancy and infection (including TB, HepB)	Complete l GFR, Liver Repeat TB pulmonary Consider b symptoms disorders
		Certolizumab	115 patients with axial spondyloarthritis and recurrent uveitis	Prospective study	<u>Episodes of uveitis</u>: More than 1: 100% (before treatment) vs. 20.2% (2 years after) More than 1: 59.6% (before treatment) vs. 11.2% (2 years after) More than 3: 17.9% (before treatment) vs. 0% (2 years after)	200mg SC every 2 weeks	Hepatotoxicity, bone marrow suppression, gastrointestinal reaction, infusion reactions, demyelination, increased risk of malignancy and infection (including TB)	Complete l GFR, Liver Repeat TB pulmonary Consider b symptoms disorders
	JAK inhibitor	Filgotinib	74 patients with non-infectious posterior segment uveitis	RCT (placebo-controlled)	<u>Treatment failure (new inflammatory lesions, anterior chamber or vitreous inflammation, or worsening of visual acuity)</u> 37.5% (filgotinib) vs. 67.6% (placebo)	200mg PO	Major cardiovascular events, malignancy, venous thromboembolism, serious infections (side-effects currently considered as class-effect from tofacitinib) Embryofetal toxicity, gastrointestinal reaction (4%), bone marrow suppression (1%), nephrotoxicity, hepatotoxicity, hyperlipidemia,	Complete l GFR, Liver pressure High suspi thromboem skin lesion Repeat TB pulmonary

Table 2 DMARDs and biologics for uveitis BID: twice a day, CI: confidence interval, HepB: hepatitis B, IV: intravenously, HZV: herpes zoster virus disease, RCT: randomized-clinical trial, SC: subcutaneously, TB: tuberculosis, TNF: tumor necrosis factor, vs: versus, QD: once a day.

Box 1: Commonly asked questions about uveitis

What are the most common causes of uveitis worldwide?

In high-income countries, 52-79% of uveitis cases are non-infectious (systemic diseases such as axial spondyloarthritis account for 37-49%). Infectious causes of uveitis such as tuberculosis and toxoplasmosis are common in low- and middle-income countries, accounting for up to 50% of cases. In 27-51% of all cases worldwide, no specific cause can be identified (idiopathic uveitis).

Which symptoms suggestive of uveitis should prompt referral to ophthalmology?

Individuals with symptoms of uveitis, such as eye pain, redness, photophobia, floaters, or vision loss, should be referred to ophthalmology. An urgent same-day referral is needed for patients with sudden vision loss or visual distortion with eye pain or redness. Patients with uveitis and signs and symptoms of systemic illness (e.g., fever, hypotension) require emergency care.

What are the first-line treatments for infectious and non-infectious uveitis?

For infectious uveitis, treatment should target the underlying infection (such as antibiotics for TB, antiviral medications for herpes) often combined with corticosteroids. For non-infectious uveitis, treatment varies by uveitis location. Anterior uveitis should be treated wth topical corticosteroid drops. First-line treatment for posterior uveitis are disease-modifying antirheumatic drugs (DMARDs; such as methotrexate); biologics such as adalimumab are second-line therapy if uveitis persists or worsens despite initial treatment with DMARDs.

References

1. Miserocchi E, Fogliato G, Modorati G, Bandello F. Review on the worldwide epidemiology of uveitis. *European journal of ophthalmology*. 2013;23(5):705-717. doi:10.5301/EJO.5000278
2. Dick AD, Tundia N, Sorg R, et al. Risk of Ocular Complications in Patients with Noninfectious Intermediate Uveitis, Posterior Uveitis, or Panuveitis. *Ophthalmology*. 2016/3// 2016;123(3):655-662. doi:10.1016/J.OPHTHA.2015.10.028
3. Cimino L, Aldigeri R, Salvarani C, et al. The causes of uveitis in a referral centre of Northern Italy. *Int Ophthalmol*. Oct 2010;30(5):521-9. doi:10.1007/s10792-010-9359-y
4. Hermann L, Falcão-Reis F, Figueira L. Epidemiology of Uveitis in a tertiary care centre in Portugal. *Semin Ophthalmol*. Feb 17 2021;36(1-2):51-57. doi:10.1080/08820538.2021.1885721
5. Bertrand PJ, Jamilloux Y, Ecochard R, et al. Uveitis: Autoimmunity… and beyond. *Autoimmunity reviews*. 2019/9// 2019;18(9)doi:10.1016/J.AUTREV.2019.102351
6. Bajwa A, Osmanzada D, Osmanzada S, et al. Epidemiology of uveitis in the mid-Atlantic United States. *Clin Ophthalmol*. 2015;9:889-901. doi:10.2147/opth.S80972
7. Bro T, Tallstedt L. Epidemiology of uveitis in a region of southern Sweden. *Acta Ophthalmol*. Feb 2020;98(1):32-35. doi:10.1111/aos.14130
8. Tsirouki T, Dastiridou A, Symeonidis C, et al. A Focus on the Epidemiology of Uveitis. *Ocul Immunol Inflamm*. 2018;26(1):2-16. doi:10.1080/09273948.2016.1196713
9. Tyagi M, Das AV, Kaza H, et al. LV Prasad Eye Institute EyeSmart electronic medical record-based analytics of big data: LEAD-Uveitis Report 1: Demographics and clinical features of uveitis in a multi-tier hospital based network in Southern India. *Indian J Ophthalmol*. Apr 2022;70(4):1260-1267. doi:10.4103/ijo.IJO_1122_21
10. Mwanza J-CK, Kayembe DL. Uveitis in HIV-Infected Patients. *European Journal of Ophthalmology*. 2001;11(1):53-56. doi:10.1177/112067210101100110
11. Barisani-Asenbauer T, MacA SM, Mejdoubi L, Emminger W, MacHold K, Auer H. Uveitis- a rare disease often associated with systemic diseases and infections- a systematic review of 2619 patients. *Orphanet journal of rare diseases*. 2012;7(1)doi:10.1186/1750-1172-7-57
12. London NJS, Garg SJ, Moorthy RS, Cunningham ET. Drug-induced uveitis. *Journal of ophthalmic inflammation and infection*. 2013;3(1):1-18. doi:10.1186/1869-5760-3-43
13. Hu J, Vu JT, Hong B, Gottlieb C. Uveitis and cystoid macular oedema secondary to topical prostaglandin analogue use in ocular hypertension and open angle glaucoma. *Br J Ophthalmol*. Aug 2020;104(8):1040-1044. doi:10.1136/bjophthalmol-2019-315280
14. Iqbal KM, Hay MW, Emami-Naeini P. Medication-induced Uveitis: An Update. *J Ophthalmic Vis Res*. Jan-Mar 2021;16(1):84-92. doi:10.18502/jovr.v16i1.8254
15. Rothova A, Ooijman F, Kerkhoff F, Van Der Lelij A, Lokhorst HM. Uveitis masquerade syndromes. *Ophthalmology*. Feb 2001;108(2):386-99. doi:10.1016/s0161-6420(00)00499-1
16. Guo X, Chen Z, Xing Y. Immune-Mediated Uveitis and Lifestyle Factors: A Review. *Ophthalmic Research*. 2021;64(5):687-695. doi:10.1159/000518496
17. Bai YC, Wang CY, Lin CL, Lai JN, Wei JC. Association Between Air Pollution and the Risk of Uveitis: A Nationwide, Population-Based Cohort Study. *Front Immunol*. 2021;12:613893. doi:10.3389/fimmu.2021.613893
18. Rothova A, Buitenhuis HJ, Meenken C, et al. Uveitis and systemic disease. *The British journal of ophthalmology*. 1992;76(3):137-141. doi:10.1136/BJO.76.3.137
19. Jabs DA, Busingye J. Approach to the diagnosis of the uveitides. *Am J Ophthalmol*. Aug 2013;156(2):228-36. doi:10.1016/j.ajo.2013.03.027
20. Chang JH, Wakefield D. Uveitis: a global perspective. *Ocul Immunol Inflamm*. Dec 2002;10(4):263-79. doi:10.1076/ocii.10.4.263.15592
21. Saari KM, Päivönsalo-Hietanen T, Vaahtoranta-Lehtonen H, Tuominen J, Sillanpää M. Epidemiology of endogenous uveitis in south-western Finland. *Acta ophthalmologica Scandinavica*. 1995;73(4):345-349. doi:10.1111/J.1600-0420.1995.TB00040.X
22. Thorne JE, Suhler E, Skup M, et al. Prevalence of Noninfectious Uveitis in the United States: A Claims-Based Analysis. *JAMA Ophthalmol*. Nov 1 2016;134(11):1237-1245. doi:10.1001/jamaophthalmol.2016.3229
23. Yeung IY, Popp NA, Chan CC. The role of sex in uveitis and ocular inflammation. *Int Ophthalmol Clin*. Summer 2015;55(3):111-31. doi:10.1097/iio.0000000000000072
24. Agrawal R, Gunasekeran DV, Agarwal A, et al. The Collaborative Ocular Tuberculosis Study (COTS)-1: A Multinational Description of the Spectrum of Choroidal Involvement in 245 Patients with Tubercular Uveitis. *Ocul Immunol Inflamm*. Sep 30 2020;28(sup1):38-48. doi:10.1080/09273948.2018.1489061
25. Alli HD, Ally N, Mayet I, Dangor Z, Madhi SA. Global prevalence and clinical outcomes of tubercular uveitis: a systematic review and meta-analysis. *Surv Ophthalmol*. May-Jun 2022;67(3):770-792. doi:10.1016/j.survophthal.2021.10.001
26. Das D, Bhattacharjee H, Bhattacharyya PK, et al. Pattern of uveitis in North East India: a tertiary eye care center study. *Indian journal of ophthalmology*. 2009/6// 2009;57(2):144-146. doi:10.4103/0301-4738.45506
27. Wakabayashi T, Morimura Y, Miyamoto Y, Okada AA. Changing patterns of intraocular inflammatory disease in Japan. *Ocular immunology and inflammation*. 2003/12// 2003;11(4):277-286. doi:10.1076/OCII.11.4.277.18260
28. Çakar Özdal MP, Yazici A, Tüfek M, Öztürk F. Epidemiology of uveitis in a referral hospital in Turkey. *Turkish journal of medical sciences*. 2014;44(2):337-342. doi:10.3906/SAG-1302-132
29. Engelhard SB, Patel V, Reddy AK. Intermediate uveitis, posterior uveitis, and panuveitis in the Mid-Atlantic USA. *Clinical ophthalmology (Auckland, NZ)*. 2015/8// 2015;9:1549-1555. doi:10.2147/OPTH.S89428
30. Jones NP, Pockar S, Steeples LR. Changing Trends in Uveitis in the United Kingdom: 5000 Consecutive Referrals to a Tertiary Referral Centre. *Ocular immunology and inflammation*. 2023;31(5):921-926. doi:10.1080/09273948.2022.2067067
31. Zeboulon N, Dougados M, Gossec L. Prevalence and characteristics of uveitis in the spondyloarthropathies: a systematic literature review. *Ann Rheum Dis*. Jul 2008;67(7):955-9. doi:10.1136/ard.2007.075754
32. Messenger W, Hildebrandt L, Mackensen F, Suhler E, Becker M, Rosenbaum JT. Characterisation of uveitis in association with multiple sclerosis. *Br J Ophthalmol*. Feb 2015;99(2):205-9. doi:10.1136/bjophthalmol-2014-305518
33. Kopplin LJ, Mount G, Suhler EB. Review for Disease of the Year: Epidemiology of HLA-B27 Associated Ocular Disorders. *Ocul Immunol Inflamm*. Aug 2016;24(4):470-5. doi:10.1080/09273948.2016.1175642
34. Tay-Kearney ML, Schwam BL, Lowder C, et al. Clinical features and associated systemic diseases of HLA-B27 uveitis. *American journal of ophthalmology*. 1996;121(1):47-56. doi:10.1016/S0002-9394(14)70533-1
35. Laroni A, Calabrese M, Perini P, et al. Multiple sclerosis and autoimmune diseases: epidemiology and HLA-DR association in North-east Italy. *Journal of neurology*. 2006/5// 2006;253(5):636-639. doi:10.1007/S00415-006-0084-4
36. de-la-Torre A, López-Castillo CA, Rueda JC, Mantilla RD, Gómez-Marín JE, Anaya JM. Clinical patterns of uveitis in two ophthalmology centres in Bogota, Colombia. *Clin Exp Ophthalmol*. Jul 2009;37(5):458-66. doi:10.1111/j.1442-9071.2009.02082.x

37. Liba T, Gorenshtein A, Leibovitch L, Gepstein R, Machinski E, Segal O. Epidemiological Characterization of Uveitis in Japan: a Systematic Review. *Ocular Immunology and Inflammation*.1-10. doi:10.1080/09273948.2025.2452193
38. Rodriguez A, Calonge M, Pedroza-Seres M, et al. Referral patterns of uveitis in a tertiary eye care center. *Archives of ophthalmology (Chicago, Ill : 1960)*. 1996;114(5):593-599. doi:10.1001/ARCHOPHT.1996.01100130585016
39. Chang JH, McCluskey PJ, Wakefield D. Acute anterior uveitis and HLA-B27. *Surv Ophthalmol*. Jul-Aug 2005;50(4):364-88. doi:10.1016/j.survophthal.2005.04.003
40. Rademacher J, Poddubnyy D, Pleyer U. Uveitis in spondyloarthritis. *Therapeutic Advances in Musculoskeletal Disease*. 2020;12:1759720X20951733. doi:10.1177/1759720x20951733
41. Jones NP. The Manchester Uveitis Clinic: the first 3000 patients--epidemiology and casemix. *Ocul Immunol Inflamm*. Apr 2015;23(2):118-26. doi:10.3109/09273948.2013.855799
42. Deschenes J, Murray PI, Rao NA, Nussenblatt RB. International Uveitis Study Group (IUSG): clinical classification of uveitis. *Ocul Immunol Inflamm*. Jan-Feb 2008;16(1):1-2. doi:10.1080/09273940801899822
43. Grange LK, Kouchouk A, Dalal MD, et al. Neoplastic masquerade syndromes in patients with uveitis. *Am J Ophthalmol*. Mar 2014;157(3):526-31. doi:10.1016/j.ajo.2013.11.002
44. Lee RWJ, Dick AD. Current concepts and future directions in the pathogenesis and treatment of non-infectious intraocular inflammation. *Eye (London, England)*. 2012;26(1):17-28. doi:10.1038/EYE.2011.255
45. Egwuagu CE, Alhakeem SA, Mbanefo EC. Uveitis: Molecular Pathogenesis and Emerging Therapies. *Frontiers in immunology*. 2021/4// 2021;12doi:10.3389/FIMMU.2021.623725
46. Durrani OM, Tehrani NN, Marr JE, Moradi P, Stavrou P, Murray PI. Degree, duration, and causes of visual loss in uveitis. *The British journal of ophthalmology*. 2004/9// 2004;88(9):1159-1162. doi:10.1136/BJO.2003.037226
47. AlBloushi AF, Ajamil-Rodanes S, Testi I, Wagland C, Grant-McKenzie N, Pavesio C. Diagnostic value of culture results from aqueous tap versus vitreous tap in cases of bacterial endophthalmitis. *Br J Ophthalmol*. Jun 2022;106(6):815-819. doi:10.1136/bjophthalmol-2021-318916
48. Gutteridge IF, Hall AJ. Acute anterior uveitis in primary care. *Clinical & experimental optometry*. 2007/3// 2007;90(2):70-82. doi:10.1111/J.1444-0938.2006.00128.X
49. Biswas J, Ganeshbabu TM, Ramesh Raghavendran S, Raizada S, Mondkar SV, Madhavan HN. Efficacy and safety of 1% rimexolone versus 1% prednisolone acetate in the treatment of anterior uveitis – a randomized triple masked study. *International Ophthalmology*. 2004/05/01 2004;25(3):147-153. doi:10.1007/s10792-004-5195-2
50. Takase H, Acharya NR, Babu K, et al. Recommendations for the management of ocular sarcoidosis from the International Workshop on Ocular Sarcoidosis. *British Journal of Ophthalmology*. 2021;105(11):1515-1519. doi:10.1136/bjophthalmol-2020-317354
51. Thorne JE, Sugar EA, Holbrook JT, et al. Periocular Triamcinolone vs. Intravitreal Triamcinolone vs. Intravitreal Dexamethasone Implant for the Treatment of Uveitic Macular Edema: The PeriOcular vs. INTravitreal corticosteroids for uveitic macular edema (POINT) Trial. *Ophthalmology*. 2019/2// 2019;126(2):283-295. doi:10.1016/J.OPHTHA.2018.08.021
52. Yeh S, Khurana RN, Shah M, et al. Efficacy and Safety of Suprachoroidal CLS-TA for Macular Edema Secondary to Noninfectious Uveitis: Phase 3 Randomized Trial. *Ophthalmology*. 2020/7// 2020;127(7):948-955. doi:10.1016/J.OPHTHA.2020.01.006
53. Jabs DA, Rosenbaum JT, Foster CS, et al. Guidelines for the use of immunosuppressive drugs in patients with ocular inflammatory disorders: recommendations of an expert panel. *Am J Ophthalmol*. Oct 2000;130(4):492-513. doi:10.1016/s0002-9394(00)00659-0
54. Zhang H, Nicholson CM, Kempen JH, Ying GS, Gangaputra SS. Management of Acute Non-Infectious Anterior Uveitis in Adults - Practice Patterns Among Uveitis Specialists in North America. *Ocul Immunol Inflamm*. May 15 2024:1-6. doi:10.1080/09273948.2024.2346819
55. Urban RC, Cotlier E. Corticosteroid-induced cataracts. *Survey of Ophthalmology*. 1986/09/01/ 1986;31(2):102-110. doi:https://doi.org/10.1016/0039-6257(86)90077-9
56. Prieto-del-Cura M, González-Guijarro JJ. Risk factors for ocular complications in adult patients with uveitis. *European journal of ophthalmology*. 2020/11// 2020;30(6):1381-1389. doi:10.1177/1120672119899379
57. Charkoudian LD, Ying GS, Pujari SS, et al. High-dose intravenous corticosteroids for ocular inflammatory diseases. *Ocular immunology and inflammation*. 2012/4// 2012;20(2):91-99. doi:10.3109/09273948.2011.646382
58. Kempen JH, Altaweel MM, Drye LT, et al. Benefits of Systemic Anti-inflammatory Therapy versus Fluocinolone Acetonide Intraocular Implant for Intermediate Uveitis, Posterior Uveitis, and Panuveitis: Fifty-four-Month Results of the Multicenter Uveitis Steroid Treatment (MUST) Trial and Follow-up Study. *Ophthalmology*. Oct 2015;122(10):1967-75. doi:10.1016/j.ophtha.2015.06.042
59. Kempen JH, Altaweel MM, Holbrook JT, et al. Randomized comparison of systemic anti-inflammatory therapy versus fluocinolone acetonide implant for intermediate, posterior, and panuveitis: the multicenter uveitis steroid treatment trial. *Ophthalmology*. 2011/10// 2011;118(10):1916-1926. doi:10.1016/J.OPHTHA.2011.07.027
60. Kempen JH, Altaweel MM, Holbrook JT, Sugar EA, Thorne JE, Jabs DA. Association Between Long-Lasting Intravitreous Fluocinolone Acetonide Implant vs Systemic Anti-inflammatory Therapy and Visual Acuity at 7 Years Among Patients With Intermediate, Posterior, or Panuveitis. *JAMA*. 2017/5// 2017;317(19):1993-2005. doi:10.1001/JAMA.2017.5103
61. NICE. Adalimumab and dexamethasone for treating non-infectious uveitis. Accessed 1/12/2024, 2024. https://www.nice.org.uk/guidance/ta460/chapter/1-Recommendations
62. Dick AD, Rosenbaum JT, Al-Dhibi HA, et al. Guidance on Noncorticosteroid Systemic Immunomodulatory Therapy in Noninfectious Uveitis: Fundamentals Of Care for UveitiS (FOCUS) Initiative. *Ophthalmology*. May 2018;125(5):757-773. doi:10.1016/j.ophtha.2017.11.017
63. Gangaputra S, Newcomb CW, Liesegang TL, et al. Methotrexate for ocular inflammatory diseases. *Ophthalmology*. Nov 2009;116(11):2188-98.e1. doi:10.1016/j.ophtha.2009.04.020
64. Daniel E, Thorne JE, Newcomb CW, et al. Mycophenolate mofetil for ocular inflammation. *Am J Ophthalmol*. Mar 2010;149(3):423-32.e1-2. doi:10.1016/j.ajo.2009.09.026
65. Deuter CME, Engelmann K, Heiligenhaus A, et al. Enteric-coated mycophenolate sodium in the treatment of non-infectious intermediate uveitis: results of a prospective, controlled, randomised, open-label, early terminated multicentre trial. *Br J Ophthalmol*. May 2018;102(5):647-653. doi:10.1136/bjophthalmol-2017-310156
66. Yazici H, Pazarli H, Barnes CG, et al. A controlled trial of azathioprine in Behçet's syndrome. *N Engl J Med*. Feb 1 1990;322(5):281-5. doi:10.1056/nejm199002013220501
67. Pasadhika S, Kempen JH, Newcomb CW, et al. Azathioprine for ocular inflammatory diseases. *Am J Ophthalmol*. Oct 2009;148(4):500-509.e2. doi:10.1016/j.ajo.2009.05.008
68. Kaçmaz RO, Kempen JH, Newcomb C, et al. Cyclosporine for ocular inflammatory diseases. *Ophthalmology*. Mar 2010;117(3):576-84. doi:10.1016/j.ophtha.2009.08.010
69. Ono T, Goto H, Sakai T, et al. Comparison of combination therapy of prednisolone and cyclosporine with corticosteroid pulse therapy in Vogt-Koyanagi-Harada disease. *Japanese journal of ophthalmology*. 2022/3// 2022;66(2):119-129. doi:10.1007/S10384-021-00878-W
70. Jaffe GJ, Dick AD, Brézin AP, et al. Adalimumab in Patients with Active Noninfectious Uveitis. *N Engl J Med*. Sep 8 2016;375(10):932-43. doi:10.1056/NEJMoa1509852

71. Nguyen QD, Merrill PT, Jaffe GJ, et al. Adalimumab for prevention of uveitic flare in patients with inactive non-infectious uveitis controlled by corticosteroids (VISUAL II): a multicentre, double-masked, randomised, placebo-controlled phase 3 trial. *Lancet*. Sep 17 2016;388(10050):1183-92. doi:10.1016/s0140-6736(16)31339-3
72. Ramanan AV, Dick AD, Jones AP, et al. Adalimumab plus Methotrexate for Uveitis in Juvenile Idiopathic Arthritis. *N Engl J Med*. Apr 27 2017;376(17):1637-1646. doi:10.1056/NEJMoa1614160
73. Quartier P, Baptiste A, Despert V, et al. ADJUVITE: a double-blind, randomised, placebo-controlled trial of adalimumab in early onset, chronic, juvenile idiopathic arthritis-associated anterior uveitis. *Ann Rheum Dis*. Jul 2018;77(7):1003-1011. doi:10.1136/annrheumdis-2017-212089
74. van Bentum RE, Heslinga SC, Nurmohamed MT, et al. Reduced Occurrence Rate of Acute Anterior Uveitis in Ankylosing Spondylitis Treated with Golimumab - The GO-EASY Study. *J Rheumatol*. Feb 2019;46(2):153-159. doi:10.3899/jrheum.180312
75. van der Horst-Bruinsma IE, van Bentum RE, Verbraak FD, et al. Reduction of anterior uveitis flares in patients with axial spondyloarthritis on certolizumab pegol treatment: final 2-year results from the multicenter phase IV C-VIEW study. *Ther Adv Musculoskelet Dis*. 2021;13:1759720x211003803. doi:10.1177/1759720x211003803
76. Srivastava SK, Watkins T, Nguyen QD, et al. A phase 2 randomized controlled trial of the Janus Kinase (JAK) inhibitor filgotinib in patients with noninfectious uveitis. *Investigative Ophthalmology & Visual Science*. 2022;63(7):2678-2678.
77. Srivastava SK, Watkins TR, Nguyen QD, et al. Filgotinib in Active Noninfectious Uveitis: The HUMBOLDT Randomized Clinical Trial. *JAMA Ophthalmol*. Jul 18 2024;doi:10.1001/jamaophthalmol.2024.2439
78. Takakura A, Tessler HH, Goldstein DA, et al. Viral retinitis following intraocular or periocular corticosteroid administration: a case series and comprehensive review of the literature. *Ocul Immunol Inflamm*. Jun 2014;22(3):175-82. doi:10.3109/09273948.2013.866256
79. Benz MS, Scott IU, Flynn HW, Jr., Unonius N, Miller D. Endophthalmitis isolates and antibiotic sensitivities: a 6-year review of culture-proven cases. *Am J Ophthalmol*. Jan 2004;137(1):38-42. doi:10.1016/s0002-9394(03)00896-1
80. Agrawal R, Testi I, Mahajan S, et al. Collaborative Ocular Tuberculosis Study Consensus Guidelines on the Management of Tubercular Uveitis-Report 1: Guidelines for Initiating Antitubercular Therapy in Tubercular Choroiditis. *Ophthalmology*. Feb 2021;128(2):266-276. doi:10.1016/j.ophtha.2020.01.008
81. Betzler BK, Putera I, Testi I, et al. Anti-tubercular therapy in the treatment of tubercular uveitis: A systematic review and meta-analysis. *Surv Ophthalmol*. Mar-Apr 2023;68(2):241-256. doi:10.1016/j.survophthal.2022.10.001
82. WHO. *Guidelines for treatment of drug-susceptible tuberculosis*. 2017.
83. Ozdemir Yalcinsoy K, Cakar Ozdal P. Ocular syphilis. *Eur Eye Res*. 2022;2(3):124-134. doi:10.14744/eer.2022.57966
84. WHO. WHO Guidelines Approved by the Guidelines Review Committee. *WHO Guidelines for the Treatment of Treponema pallidum (Syphilis)*. World Health Organization
© World Health Organization 2016.; 2016.
85. Workowski KA, Bachmann LH, Chan PA, et al. Sexually Transmitted Infections Treatment Guidelines, 2021. *MMWR Recomm Rep*. Jul 23 2021;70(4):1-187. doi:10.15585/mmwr.rr7004a1
86. Zhang T, Zhu Y, Xu G. Clinical Features and Treatments of Syphilitic Uveitis: A Systematic Review and Meta-Analysis. *J Ophthalmol*. 2017;2017:6594849. doi:10.1155/2017/6594849
87. Thng ZX, Putera I, Testi I, et al. The Infectious Uveitis Treatment Algorithm Network (TITAN) Report 1-global current practice patterns for the management of Herpes Simplex Virus and Varicella Zoster Virus anterior uveitis. *Eye (Lond)*. Jan 2024;38(1):61-67. doi:10.1038/s41433-023-02630-9
88. Thng ZX, Putera I, Testi I, et al. The Infectious Uveitis Treatment Algorithm Network (TITAN) Report 2-global current practice patterns for the management of Cytomegalovirus anterior uveitis. *Eye (Lond)*. Jan 2024;38(1):68-75. doi:10.1038/s41433-023-02631-8
89. Zandi S, Bodaghi B, Garweg JG. Review for Disease of the Year: Treatment of Viral Anterior Uveitis: A Perspective. *Ocular Immunology and Inflammation*. 2018/10/03 2018;26(7):1135-1142. doi:10.1080/09273948.2018.1498109
90. Brodie JT, Thotathil AZ, Jordan CA, Sims J, Niederer RL. Risk of Recurrence in Acute Anterior Uveitis. *Ophthalmology*. 2024/06/08/ 2024;doi:https://doi.org/10.1016/j.ophtha.2024.06.003
91. Lin P. Infectious Uveitis. *Curr Ophthalmol Rep*. Sep 2015;3(3):170-183. doi:10.1007/s40135-015-0076-6
92. La Distia Nora R, Putera I, Mayasari YD, et al. Clinical characteristics and treatment outcomes of cytomegalovirus anterior uveitis and endotheliitis: A systematic review and meta-analysis. *Survey of Ophthalmology*. 2022;67(4):1014-1030. doi:10.1016/j.survophthal.2021.12.006
93. Ude IN, Yeh S, Shantha JG. Cytomegalovirus retinitis in the highly active anti-retroviral therapy era. *Annals of Eye Science*. 2021;7:5.
94. Chiang W-Y, Lin C-P, Cho W-H, et al. Cytomegalovirus Uveitis: Taiwan expert consensus. *Journal of the Formosan Medical Association*. 2023/08/01/ 2023;122(8):668-674. doi:https://doi.org/10.1016/j.jfma.2023.03.014
95. Khan FA, Slain D, Khakoo RA. Candida Endophthalmitis: Focus on Current and Future Antifungal Treatment Options. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy*. 2007;27(12):1711-1721. doi:https://doi.org/10.1592/phco.27.12.1711
96. Rex JH, Bennett JE, Sugar AM, et al. A Randomized Trial Comparing Fluconazole with Amphotericin B for the Treatment of Candidemia in Patients without Neutropenia. *New England Journal of Medicine*. 1994;331(20):1325-1330. doi:doi:10.1056/NEJM199411173312001
97. Pappas PG, Kauffman CA, Andes DR, et al. Clinical Practice Guideline for the Management of Candidiasis: 2016 Update by the Infectious Diseases Society of America. *Clin Infect Dis*. Feb 15 2016;62(4):e1-50. doi:10.1093/cid/civ933
98. Patterson TF, Thompson GR, 3rd, Denning DW, et al. Practice Guidelines for the Diagnosis and Management of Aspergillosis: 2016 Update by the Infectious Diseases Society of America. *Clin Infect Dis*. Aug 15 2016;63(4):e1-e60. doi:10.1093/cid/ciw326
99. Kalogeropoulos D, Sakkas H, Mohammed B, et al. Ocular toxoplasmosis: a review of the current diagnostic and therapeutic approaches. *Int Ophthalmol*. Jan 2022;42(1):295-321. doi:10.1007/s10792-021-01994-9
100. Pradhan E, Bhandari S, Gilbert RE, Stanford M. Antibiotics versus no treatment for toxoplasma retinochoroiditis. *Cochrane Database Syst Rev*. May 20 2016;2016(5):Cd002218. doi:10.1002/14651858.CD002218.pub2
101. Feliciano-Alfonso JE, Muñoz-Ortiz J, Marín-Noriega MA, et al. Safety and efficacy of different antibiotic regimens in patients with ocular toxoplasmosis: systematic review and meta-analysis. *Systematic Reviews*. 2021/07/19 2021;10(1):206. doi:10.1186/s13643-021-01758-7
102. Maini R, O'Sullivan J, Reddy A, Watson S, Edelsten C. The risk of complications of uveitis in a district hospital cohort. *Br J Ophthalmol*. Apr 2004;88(4):512-7. doi:10.1136/bjo.2002.013334
103. Engelhard SB, Haddad Z, Bajwa A, Patrie J, Xin W, Reddy AK. Infectious uveitis in Virginia. *Clin Ophthalmol*. 2015;9:1589-94. doi:10.2147/opth.S86578
104. Ahmed AS, Nivedita N, Sudharshan S, et al. Ocular Syphilis - Clinical Features and Outcome in HIV Positive and HIV Negative Patients from a Tertiary Eye Center from India - A Comparative Study. *Ocul Immunol Inflamm*. Aug 15 2024:1-8. doi:10.1080/09273948.2024.2382347
105. Sittivarakul W, Treerutpun W, Tungsattayathitthan U. Clinical characteristics, visual acuity outcomes, and factors associated with loss of vision among patients with active ocular toxoplasmosis: A retrospective study in a Thai tertiary center. *PLoS Negl Trop Dis*. Jun 2024;18(6):e0012232. doi:10.1371/journal.pntd.0012232
106. Tomkins-Netzer O, Lightman SL, Burke AE, et al. Seven-Year Outcomes of Uveitic Macular Edema: The Multicenter Uveitis Steroid Treatment Trial and Follow-up Study Results. *Ophthalmology*. 2021/5// 2021;128(5):719-728. doi:10.1016/J.OPHTHA.2020.08.035
107. Suhler EB, Jaffe GJ, Fortin E, et al. Long-Term Safety and Efficacy of Adalimumab in Patients with Noninfectious Intermediate Uveitis, Posterior Uveitis, or Panuveitis. *Ophthalmology*. 2021/6// 2021;128(6):899-909. doi:10.1016/J.OPHTHA.2020.10.036