

Anterior uveitis in children

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Abstract

Uveitis can cause major visual disabilities in children. Anterior uveitis accounts for approximately one-third of all cases of uveitis. The most frequent associated condition is juvenile rheumatoid arthritis, and Masquerade syndrome should always be considered. Screening patients with juvenile rheumatoid arthritis for anterior uveitis is worthwhile. The first-line therapy for anterior uveitis is a steroid. The second-line therapy is an immunosuppressive agent, among which methotrexate is the most commonly used. Cataract, as a complication of the disease or of steroid use, can be treated by surgery. However, operating in an inflamed eye of a child requires extra care. Glaucoma is another complication of uveitis, and can be treated primarily with antiglaucoma eye drops; surgery may be considered. Band keratopathy is another complication that may be treated with surgery.

Key words: Arthritis, juvenile rheumatoid, Child, Uveitis

Introduction

Children have been shown to constitute 5% to 10% of patients with uveitis seen at a tertiary referral center.¹ Anterior uveitis accounts for approximately 30% to 40% of patients, intermediate uveitis for 10% to 20%, posterior uveitis for 40% to 50%, and panuveitis for 5% to 10%.¹

Anterior uveitis in children differs in many aspects from that in adults. Juvenile rheumatoid arthritis (JRA) is the most frequent associated condition in children, accounting for approximately 20% of patients with anterior uveitis (**Table 1**).² Steroids may be used as first-line therapy to control the inflammation, but immunosuppressive agents may need to be used as second-line therapy if steroids fail.^{3,4} Both of these classes of drugs have adverse effects on a child's growth. Cataract and glaucoma, which can be complications of the disease or of the side effects of treatment, are more common in children than in adults.⁵ Surgical treatment for

Table 1. Systemic and ocular diseases associated with anterior uveitis in children.²

Associated disease	Percent of patients
Juvenile rheumatoid arthritis	20.0
Fuch's heterochromic iridocyclitis	4.0
Herpes simplex	3.0
Tuberculosis	1.0
Syphilis	1.0
Ankylosing spondylitis	1.0
Kawasaki disease	<1.0
Psoriatic arthritis	<1.0
Acute interstitial nephritis	<1.0
Reiter's syndrome	0.5

these complications in an inflamed eye of a child requires special care.⁶ The disease also has a social impact on the child. The frequent follow-ups cause absence from school and administration of eye drops in children can be difficult. The potential loss of vision has a greater impact over a child's lifespan than over an adult's in terms of financial burden and loss of productivity. This article focuses on anterior uveitis and its complications and management in pediatric patients.

Anterior uveitis

In the USA and Europe, the incidence of anterior uveitis is approximately 4.3 to 6.0 per 100,000 population⁷⁻⁹ and the prevalence is 30.0 per 100,000 population.^{8,9} However, these figures may be higher in developing countries.¹ No comparable figure is currently available for Hong Kong. Girls appear to be more commonly affected than boys.^{10,11} Anterior uveitis in children has a different etiology from that in adults (**Table 1**).² Most cases are idiopathic. The most commonly associated disease is JRA, which is present in approximately 20% of patients.^{2,5,7,10,12-14}

Juvenile rheumatoid arthritis

JRA is a chronic disease of children younger than 16 years and lasts more than 3 months. JRA can be clinically

Table 2. Characteristics of the different types of juvenile rheumatoid arthritis.¹⁵

	Systemic	Pauciarticular (type I — early onset)	Pauciarticular (type II — late onset)	Polyarticular
Percent of patients	15-20	35	15	30-50
Gender predilection	Male	Female	Male	Female
Uveitis risk (%)	Rare	40-50	10-20	5-7
Other characteristics		Positive for antinuclear antibodies in 50%	Human leucocyte antigen B27–positive Associated with ankylosing spondylitis	Positive for antinuclear antibodies in 25%

separated into 3 groups that have different associations with uveitis in children: systemic disease with fever, malaise, rash, and hepatosplenomegaly; pauciarticular disease with fewer than 4 joints involved in the first 6 months of onset; and polyarticular disease with more than 4 joints involved (**Table 2**).¹⁵

The clinical features of JRA-associated uveitis have been described in various publications.¹⁵⁻²⁶ Ocular redness, pain and photophobia, which are typical signs and symptoms of acute anterior uveitis, may be absent in JRA-associated uveitis. Complications, including cataract, glaucoma, band keratopathy, and posterior synechiae, may have occurred by the time of the first presentation to a clinician. Phthisis may ensue in the final stages.^{19,27} There is no hypopyon or posterior uveitis present. Arthritis usually precedes the uveitis, with the median interval between the occurrence of the 2 conditions reported to be less than 1 year.^{19,23,24} Blood testing for immunoglobulin M rheumatoid factor gives negative results.¹³ Other causes of arthritis should be excluded.¹⁴

Patients with pauciarticular involvement and positive for antinuclear antibodies are particularly susceptible to uveitis.^{15,16} Ohno et al found that such antibodies were present in 71% of patients with JRA-associated uveitis, but in only 32% of patients with idiopathic uveitis.²⁵ Owing to the asymptomatic nature of uveitis, screening is important for children at risk for at least 7 years after the onset of arthritis (**Table 3**).²⁸ Although anterior uveitis is most likely idiopathic or related to JRA, the condition can also be the initial clinical presentation of underlying ocular disease that can be life-threatening — masquerade syndrome.²⁹⁻³¹

Masquerade syndrome

Masquerade syndrome may be malignant or non-malignant. Examples include retinoblastoma, leukemia, lymphoma,

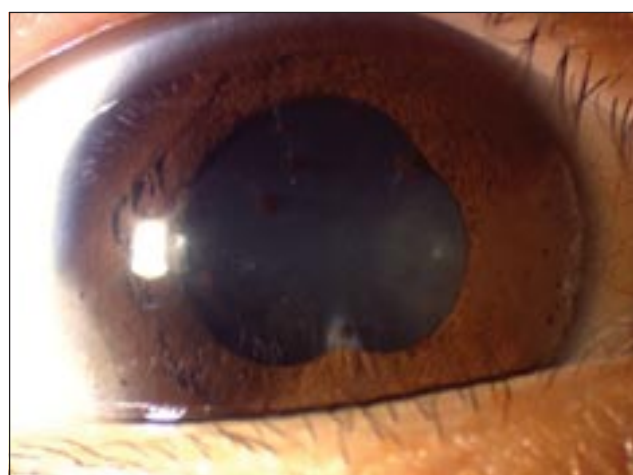
juvenile xanthogranuloma, intraocular foreign body, and rhegmatogenous retinal detachment. Ophthalmic ultrasonography, computed tomography, complete blood count, lymph node or bone marrow biopsy, and vitreous or aqueous aspiration may be helpful for making the diagnosis.

Complications of anterior uveitis

With early diagnosis and prompt treatment, the inflammation of anterior uveitis usually subsides within weeks.³²⁻³⁴ The poor response reported for children is directly related to the delay in diagnosis, which results in more frequent complications for children than for adults.⁵

Complications of anterior uveitis include band keratopathy, secondary glaucoma, posterior synechiae (**Figure 1**), cataract formation, inflammatory membranes, macular edema, hypotony, and phthisis.^{1,5,12} Importantly, complications of uveitis have a particular bearing in children because of the risk of development of amblyopia.

Children with JRA-associated uveitis appear to be at a much greater risk of complications than those with other forms of uveitis.⁷ Foster and Barret reported that even with aggressive anti-inflammatory therapy, 18% of patients with JRA-associated uveitis who had at least 1 year of follow-up developed secondary cataracts.³⁵ Foster et al also found that uveitic glaucoma or elevated intraocular pressure (IOP) occurred in 42% of patients with JRA-associated uveitis at a mean interval of 9.2 years.³⁶

**Figure 1. Posterior synechiae.****Table 3. Screening for uveitis in children with juvenile rheumatoid arthritis.²⁸**

Type of juvenile rheumatoid arthritis	Screening frequency
Systemic onset	Not required
Polyarticular	Every 9 months
Polyarticular with antinuclear antibodies	Every 6 months
Pauciarticular	Every 4 months
Pauciarticular with antinuclear antibodies	Every 3 months

Ciliary membrane formation may cause tractional detachment of the ciliary body. Chronic uveitis can also lead to ciliary body atrophy with hypotony.^{37,38} Ultrasonographic biomicroscopy plays an important role in the evaluation of the status of the ciliary body in children with uveitis. Band keratopathy is common and severe in children,⁴ and may cause amblyopia if the visual axis is affected. This may lead to contact lens intolerance after cataract extraction.

Various clinical and laboratory factors have been proposed to be associated with the long-term complications of JRA-associated uveitis. These include a short interval between the onset of arthritis and the diagnosis of uveitis, the severity of disease at presentation, the presence of complications at initial examination, sex, age at onset of uveitis, and elevated α_2 -globulins.^{19,20,22-24} Since various studies have used different endpoints, consistent results have not been produced. However, in a multivariate analysis, the severity of the disease at the onset of uveitis was shown to be the strongest predictor for long-term complications and visual loss.^{17,20} Male sex is also an independent risk factor for a poor long-term outcome.¹⁷ Laser flare photometry, which is an objective and quantitative method to document the aqueous humor protein level in the anterior chamber, also shows promising results for prediction of complications.

Medical treatment

Collaboration between ophthalmologists, pediatricians, and physicians is essential for the treatment of uveitis in children. Therapy aims to suppress the inflammatory activity to preserve vision and to prevent serious complications. Unfortunately, there are few randomized controlled clinical trials to guide the choice of drug therapy for pediatric patients with uveitis.

Steroid therapy

Steroids have been safely used as the first-line treatment for uveitis for more than 50 years. However, steroids are associated with a multitude of adverse effects. Thus, a stepped steroid-sparing algorithmic approach to treatment is advocated.

For patients with mild iritis, satisfactory results may be achieved with the use of cycloplegics and topical corticosteroids.³⁹ Children start with intensive topical steroids (as frequently as every 15 minutes) based on the degree of inflammation.²⁹ Prednisolone acetate 1.0% effectively penetrates the cornea and has a relatively potent anti-inflammatory activity. Meanwhile, a short-acting cycloplegic such as 4% homatropine or a long-acting agent such as 1% atropine may be used. The action of a cycloplegic agent is to pull away the pupillary margin to minimize the formation of posterior synechiae. Cycloplegic agents also relax the iris musculature and ciliary spasm to relieve tension and pain and may stabilize the membrane of the blood-aqueous barrier to prevent further leakage. Steroids should be slowly tapered as the inflammation subsides. Flare is not an indication for continued steroid therapy.

Subconjunctival injection of steroid delivers high doses to the anterior segment of the eye but, as intensive topical application is effective for controlling the anterior segment inflammation and does not require general anesthesia, such an injection is rarely used to treat uveitis in pediatric patients. For unilateral posterior or intermediate uveal inflammation, some clinicians favor the use of a steroid injection either along the orbital floor or into the posterior sub-Tenon's space. Smith preferred an inferior peribulbar injection of triamcinolone acetonide 40 mg/mL (0.095 mL) and 2% lidocaine (lignocaine) (0.005 mL) using a 1-inch 25-gauge needle inserted through the lower lid.⁴⁰ The injection may be repeated once every 3 weeks for a total of 3 injections to achieve a therapeutic response.

Systemic steroids may be used for more severe conditions if topical medications fail.⁴⁰⁻⁴³ However, chronic steroid use may be associated with cataract formation, scleral thinning, and glaucoma, which may also contribute to vision loss. In addition to these adverse effects, some patients may be unresponsive to steroid therapy.⁴⁴ Other medical therapy may therefore be necessary.

After 6 months of steroid treatment and/or if attempted withdrawal of steroid therapy leads to recurrence of the inflammation, an oral non-steroidal anti-inflammatory drug (NSAID) is recommended.²⁹

Non-steroidal anti-inflammatory drugs

NSAIDs inhibit prostaglandin production by suppressing the activity of the cyclo-oxygenase (COX) pathway. Non-selective COX enzyme inhibitors can cause gastrointestinal adverse effects, while the newer selective COX-2 NSAIDs such as meloxicam, celecoxib, and rofecoxib are associated with fewer gastric adverse effects. Other NSAIDs such as tolmetin 20 to 30 mg·kg⁻¹·d⁻¹ in 4 divided doses or naproxen 10 to 15 mg·kg⁻¹·d⁻¹ in 2 divided doses have the longest safety record for pediatric use.

Although steroids and NSAIDs can control pediatric uveitis for most patients, medical therapy tends to be more challenging for children with uveitis than for adults.²⁶ A number of factors contribute to this situation, including poor compliance with frequent dosing schedules, increased tendency for corticosteroids to induce ocular hypertension⁴⁵ and cataract,⁴⁶ and the occurrence of corticosteroid-induced growth retardation in prepubescent children.⁴⁷ Such considerations have led to recommendations for early use of corticosteroid-sparing agents such as methotrexate⁴⁸ and cyclosporin A^{49,50} for children with chronic non-infectious uveitis.⁵¹ Chlorambucil and sulfasalazine — a slow-acting antirheumatic drug — are other second-line immunosuppressive agents that may be considered.

Immunosuppressive agents

Methotrexate is the drug that is most commonly used as a steroid-sparing agent for children with uveitis. Methotrexate inhibits folate synthesis by irreversibly binding to dihydrofolate reductase, thereby resulting in reduced DNA

and RNA synthesis and lymphocyte cell proliferation.⁵² Low-dose methotrexate has been shown to be effective for the treatment of a variety of chronic inflammatory disorders. Oral methotrexate can be given in a weekly dose of 7.25 to 12.50 mg/m². Treatment can be initiated with half the total dose and increased every 2 weeks until the final dose is reached. Complete blood counts, liver function tests, and urinalysis should be conducted every 2 weeks for the first month and monthly thereafter to monitor drug toxicity.

The principal toxicities of methotrexate are directed to the liver, bone marrow, and lungs. Severe toxicity is rare in children. Gastrointestinal adverse effects are most common with oral medication but can be reduced by using intramuscular methotrexate. Oral ulceration and alopecia are common. Bone marrow suppression with the risk of infectious complications are infrequently reported and should be checked for by regular complete blood counts. Pulmonary complications in children are exceedingly rare. Graham et al performed pulmonary function tests in 46 patients with JRA before methotrexate therapy and 1 year afterwards, and found no significant adverse effects.⁵³ However, there has been a case report of induced hypersensitivity pneumonitis in a girl treated with methotrexate.⁵⁴

A number of non-blinded studies have reported success with treating pediatric uveitis with methotrexate. Weiss et al treated 7 patients, aged 4 to 22 years, with methotrexate for JRA-associated uveitis that was either inadequately suppressed with steroids or associated with steroid-related side effects.⁵⁵ Six of 7 patients were able to cease or reduce steroid treatment without exacerbation of the disease. The condition significantly improved in terms of anterior chamber cells and visual acuity. In another study, Shetty et al used methotrexate to treat steroid-resistant anterior uveitis in 2 children with sarcoidosis and 2 children with JRA.⁵⁶ Disease resolution was achieved in 2 children, and clinical improvement was seen in the remaining 2 patients. The steroid dosage was able to be reduced for all patients. Methotrexate is effective, generally well-tolerated, easy to administer, and inexpensive. If methotrexate therapy fails or is not well-tolerated, other immunomodulators such as cyclosporin A (2-5 mg·kg⁻¹·d⁻¹)⁵⁷⁻⁶⁶ or chlorambucil (0.10-0.16 mg·kg⁻¹·d⁻¹)⁶⁷⁻⁷⁶ may be substituted. Sulfasalazine has also been proposed.⁷⁷⁻⁸⁵ Drugs that inhibit tumor necrosis factor (TNF) may be effective for controlling uveal inflammation. Etanercept, a TNF- α inhibitor,⁸⁶⁻⁹² is a good example.

For most pediatric patients with non-infectious uveitis, the recommendations of Foster et al apply.^{3,5,14,26} Patients should be treated early with aggressive anti-inflammatory therapy to prevent development of vision-threatening complications even if the patients have only low-grade anterior chamber cellular reaction at presentation. This is especially important for children with JRA-associated uveitis.

In summary, intensive topical steroid treatment should be initiated. If anterior chamber inflammation increases as the frequency of the topical steroid is tapered to less than 4

times daily, a steroid-sparing agent, usually methotrexate, is recommended.⁴ Once methotrexate is started, it is usually continued for 1 to 2 years if it is found to be effective and well tolerated. If monotherapy with an immunosuppressive agent fails to control the inflammation, treatment strategies include changing the drug or supplementation with a second agent.⁴ Changing the drug is also recommended if there is drug intolerance or substantial side effects. A second drug is supplemented if some treatment effect is demonstrated, but the disease is not optimally controlled. Cyclosporine is the drug of choice to add to the existing regimen.

Management of complications of pediatric uveitis

Approximately 30% of children with uveitis develop 1 or more complications during the course of the disease.^{21,93} Patients with JRA-associated uveitis have the highest rate of complications, with incidences of cataract of up to 70%, band keratopathy of up to 65%, glaucoma of up to 30%, and phthisis of up to 17%.^{5,22} Urgent surgery may be necessary for vision-threatening complications such as ciliary membrane formation with ciliary body detachment, retinal detachment, or uncontrolled elevation of IOP. In contrast, cataract extraction and other elective surgeries should be deferred until the inflammation has been controlled for at least 3 months.⁹⁴ Deferral of surgery may require that children have special educational arrangements such as low vision aids or individual tutors until surgery can be performed. The medical advantages of deferral, however, should be weighed against the risks of amblyopia in very young children with unilateral cataracts.⁴

Cataract

Cataract formation is the most frequent complication for children with chronic uveitis. This may be a sequela of the chronic inflammation or long-term treatment with corticosteroids.⁹⁴ Cataract surgery in children with uveitis can be technically challenging because of the small eyes, lack of scleral rigidity, high rates of pre-existing complications, and inflammation.⁴

A variety of surgical techniques have been described for cataract extraction in children with uveitis. The initial results of cataract surgery in children with JRA by needling and aspiration were disappointing.⁹⁵ The pars plana lensectomy-vitreotomy approach has been advocated as a more successful technique, with better visual outcomes and fewer complications.^{96,97} However, this technique involves the complete removal of the lens, and anterior vitreous without intraocular lens (IOL) implantation, which commits the patient to life-long dependence on aphakic correction. Recent developments using standard phacoemulsification techniques, in some cases combined with posterior capsulotomy and vitrectomy through an anterior approach and IOL implantation, have shown promising results.⁹⁸⁻¹⁰¹

Although IOL implantation at the time of cataract surgery has been successfully performed in other forms of uveitis,

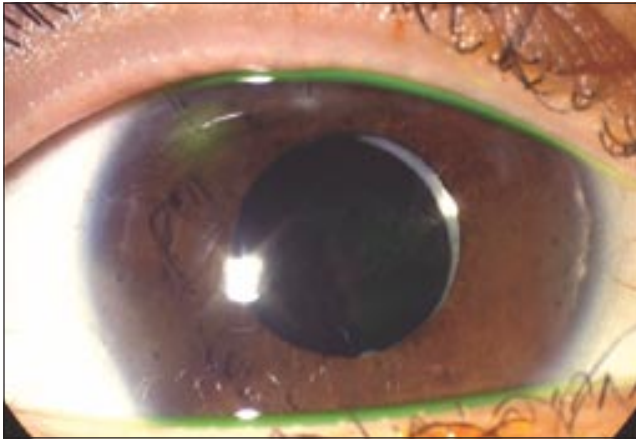


Figure 2. Cataract extraction with intraocular lens implanted.

strong reservations have been expressed regarding IOL implantation in eyes with uveitis associated with JRA, as long-term outcome data are limited (**Figure 2**).^{18,102} The IOL may serve as scaffolding for inflammatory membranes to form and postoperative inflammation is particularly exuberant in children.^{18,103} On the other hand, contact lenses are associated with substantial expense and poor compliance; contact lens intolerance is reported to be 17% to 38% among children.^{35,104} Contact lens wear may be impossible for patients with severe band keratopathy, and there may be an increased risk of contact lens-related infection in patients who require chronic topical steroid therapy. In addition, children are often intolerant to aphakic spectacles because of the weight and aniseikonia.

In a series of 7 children with JRA who underwent phacoemulsification and IOL implantation, the outcome was less favorable compared with adults.¹⁰⁰ Complications included posterior synechiae formation, elevated IOP, and pupillary membrane formation (**Figure 3**). In this series, for 5 days preoperatively and for an unspecified postoperative period, topical corticosteroids were given at a frequency ranging from 4 times daily to hourly. These eyes also received intraoperative subconjunctival corticosteroid. It should be noted, however, that no systemic immunosuppressive agent other than corticosteroid was given. Lundvall and Zetterstrom described 10 eyes of 7 children with uveitis that underwent cataract surgery with implantation of a heparin-surface

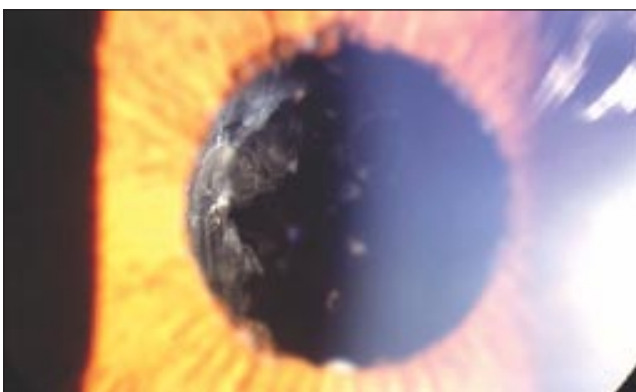


Figure 3. Fibrinous material at the pupil margin as a result of inflammation after cataract extraction.

modified polymethyl methacrylate posterior chamber IOL.⁹⁹ For 7 of the 10 eyes, inflammatory membrane formation necessitated reoperation. In contrast, Lam et al more recently described phacoemulsification and IOL implantation in 6 eyes of 5 patients with JRA, none of whom developed vision-threatening complications despite a long follow-up period (median, 43.5 months).⁹⁸ These researchers attributed their results to meticulous control of inflammation with systemic immunosuppression in addition to intensive topical corticosteroids before and after surgery. However, even with intensive anti-inflammatory therapy and well-controlled disease at the time of surgery, inflammatory membranes and other complications can eventually develop that require explantation of the IOL.¹⁰⁵ Such complications most commonly occur in patients with JRA and those who have inflammation in the intermediate portion of the eye, as seen with pars planitis syndrome. Since most of these recent series have involved less than 20 patients with a relatively short follow-up period, it is difficult to recommend IOL implantation as a routine procedure for all patients. However, meticulous pre- and postoperative control of inflammation with various immunosuppressive agents seems to be promising for achieving favorable outcomes after cataract surgery with implantation of an IOL in selected children with JRA-associated uveitis.^{6,94,99} Rehabilitation of vision with aphakic correction is most successful when children with uveitis have aphakia in both eyes.¹⁰¹ Failure of aphakic contact lens rehabilitation is particularly high in young children with uveitis who undergo unilateral surgery and have good visual acuity in the other phakic eye.¹⁰¹ These children may be the most appropriate candidates for IOL implantation.

The most common postcataract extraction complication in children with uveitis is posterior capsular opacification that can lead to amblyopia (**Figure 4**).^{99-101,106} Young age is a risk factor for postoperative opacification, even in children without uveitis. The rate of posterior capsule opacification ranges from 70% to 100%.⁹⁸⁻¹⁰¹ The rate of reoperation for removal of secondary membranes ranges from 30% to 60%.⁹⁹⁻¹⁰¹ Postoperative neodymium:YAG (Nd:YAG) laser capsulotomy can be difficult to perform in young children owing to poor cooperation. Some surgeons advocate primary posterior capsulotomy with anterior vitrectomy through an

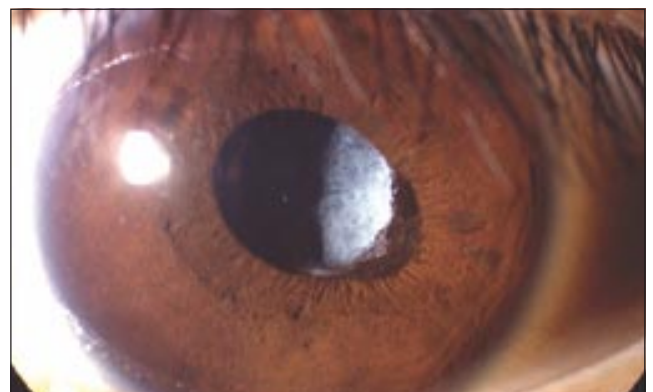


Figure 4. Posterior capsular opacification after cataract extraction.

anterior approach at the time of cataract surgery so as to maintain a clear visual axis.^{99,101,106} While this procedure does not preclude the implantation of an IOL, it does not necessarily prevent postoperative formation of retrolenticular membranes.¹⁰¹ A recent study by Lam et al showed a low rate of reoperation (17%) for posterior capsule opacification. The authors attributed this to the effect of long-term topical and systemic immunosuppressive medication use.⁹⁸

Pars plana vitrectomy with removal of all lens material and the posterior capsule through a posterior approach has been advocated as a means of preventing ciliary membrane formation.^{35,107,108} These procedures, however, preclude the use of IOLs. It seems appropriate to plan each surgery on an individual basis, with consideration of such factors as the ease with which inflammation is controlled, the existence of ciliary membranes, the tendency to form posterior synechiae, and the age of the patient. For patients without complications or vitreous humor changes and whose inflammation is well controlled, routine cataract extraction with retention of the posterior capsule and vitreous humor usually gives excellent long-term results.⁴

Another frequently reported complication after cataract extraction in children with uveitis is posterior synechiae formation, which ranges from 66%¹⁰⁰ to 100%.¹⁰¹ However, posterior synechiae formation was not noted in the series by Lam et al.⁹⁸ This is presumably attributable to the meticulous pre- and postoperative control of inflammation. Even with good initial postoperative results, patients may still develop progressive loss of vision over time after cataract extraction. Glaucoma and macular disease have been noted to be the major reasons for this progressive visual deterioration.¹⁰⁹

Glaucoma

Glaucoma often complicates chronic anterior uveitis in children, especially in conjunction with juvenile rheumatoid arthritis.^{12,110,111} This secondary glaucoma, presumably caused by progressive inflammatory damage to the aqueous outflow pathways and closure of the anterior chamber angle by peripheral anterior synechiae,³⁶ often becomes refractory to medical treatment.¹² Foster et al noted that IOP could be controlled with topical medications in only 17% of children with JRA and uveitic glaucoma, while the IOP could be controlled in 37% of patients with a combination of topical medications and an oral carbonic anhydrase inhibitor.³⁶ Tolerance of some glaucoma medications also differs between children and adults.⁴ While acetazolamide is better tolerated in young patients, topical brimonidine can cause somnolence and decreased alertness in many young children. Pilocarpine, which is rarely used for the management of inflammatory glaucoma, may cause pain in children.

Surgical treatment of secondary glaucoma in children with uveitis is a challenge. Most series describing the surgical management of glaucoma in children with uveitis focused on those with JRA. Techniques described included trabeculectomy with intraoperative application of

mitomycin C,³⁶ standard goniotomy,¹¹² trabeculodialysis,³⁶ and implantation of drainage devices.^{36,113} Trabeculectomy in young patients can be complicated by excessive scarring and lifelong risks of bleb leakage and infection, especially with the use of antiproliferative agents.¹¹⁴ The use of glaucoma drainage devices for treatment of pediatric refractory glaucoma has varied success and complications.^{115,116} It is hard to compare the effectiveness of different reported techniques owing to the different criteria for success and duration of follow-up. In a large proportion of successful surgeries, children still need to continue with topical medications for optimum IOP control.

Band keratopathy

Unless the band results in a cosmetic defect or impairs visual acuity, treatment is not indicated. The condition may be treated with chelating agents^{2,117,118} or with phototherapeutic keratectomy.¹¹⁹

When chelating agents are used,² de-epithelialisation of the cornea should be done first. Then, gel foam, moistened with 0.1 mol/L edentate disodium (sodium versenate) solution, is placed over the affected cornea — 5- to 10-minute applications produce chelation of the band. Patching then aids re-epithelialisation. This process can be repeated.

Stewart and Morrell found that phototherapeutic keratectomy resulted in visual improvement for 55% of patients with band keratopathy.¹¹⁹

The future

Advances have been made in developing new drugs for control of uveitis. TNF is a proinflammatory cytokine that has been strongly implicated in the pathogenesis of various inflammatory diseases, including uveitis. Therefore, in theory, drugs that inhibit TNF may have definite advantages for controlling uveal inflammation. Etanercept is a TNF- α inhibitor.⁸⁶⁻⁹² Some studies have shown it to be useful for the management of diseases associated with pediatric uveitis, including JRA.⁸⁸

Summary

Because of the chronic, indolent nature of ocular inflammation in children with uveitis and the frequent development of serious complications if not properly treated, pediatric uveitis poses a special challenge for ophthalmologists. The importance of screening for ocular complications, especially for those associated with JRA, cannot be overemphasized. Coordination of care with pediatric rheumatologists experienced in the management of inflammatory diseases and the use of systemic immunosuppressive agents is important. Even though substantial progress has been made during the past few decades, the rate of visual loss in children with uveitis still surpasses that of adults. Early diagnosis and aggressive anti-inflammatory therapy remain the most promising means for improving long-term outcomes for children with uveitis.

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