Chapter 21
Cataract Surgery and IOL Implantation in Children with Uveitis

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Cataract formation is a common complication of pediatric uveitis due to chronic inflammation and corticosteroid use. Although the safety of cataract extraction with IOL implantation has been validated in children, perioperative management and even IOL implantation itself in children with uveitis is controversial [10]. Current literature is sparse and limited in power, consisting of small retrospective studies.

The most common cause of uveitis in childhood is juvenile idiopathic arthritis (JIA) associated, especially patients that are antinuclear antibody (ANA) positive with oligoarticular arthritis. Less common causes include pars planitis, sarcoidosis, toxoplasmosis, toxocariasis, and herpetic infections [1–3]. Additionally, many cases of uveitis are idiopathic [2, 4, 5]. Complications of chronic inflammation include posterior synechiae, ciliary body inflammation, cyclitic membranes which can be thick and robust in children with uveitis, band keratopathy, uveitic glaucoma, hypotony, and cataracts. The diagnosis and timely management of cataracts is especially important in children given their risk for developing amblyopia, but it is critical to recall that perioperative protocols for cataract surgery in children cannot be directly applied to children with uveitis. Similarly, protocols for cataract surgery in the setting of adult uveitis cannot be directly applied to children.

Determining the optimal timing for cataract surgery in pediatric uveitis requires balancing the competing interests of delaying surgery until inflammation is adequately controlled to reduce the unique risks of intraoperative and postoperative complications, with the increased risk of developing amblyopia in the setting of surgical delay. Timing considerations should include etiology of the uveitis, severity

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of inflammation, efficacy of therapy, secondary complications of uveitis, visual potential of the eye, and risk of amblyopia conferred by the morphology and density of the cataract in light of the patient's age. Pediatric uveitis with visually significant cataract formation typically requires systemic corticosteroid-sparing immunomodulatory therapy (IMT) in consultation with a pediatric rheumatologist. The definition of sufficient uveitis control varies by etiology and expert opinion but most experts recommend a minimum of 3 months of uveitis quiescence prior to surgery [13, 14], and some physicians advocate for longer periods of sufficient inflammatory control prior to cataract surgery [4, 6]. Particularly in the pediatric population, cooperation with slit lamp and fundus examination and ancillary testing may limit the data available for clinical decision making.

Experts agree that limiting the inflammation caused by cataract surgery is critical and requires additional intensive perioperative topical and systemic corticosteroids, even with excellent preoperative inflammatory control [11, 12]. Our practice generally is to use oral prednisone 1 mg/kg/day for 2 days prior to surgery and an intraoperative dose of intravenous systemic corticosteroid (methylprednisolone or dexamethasone). Depending on uveitis severity, postoperative corticosteroid treatment may be solely topical or a combination of systemic and topical corticosteroids. In pediatric uveitis patients, postoperative corticosteroids are tapered over a longer period and are more frequently adjusted based on clinical examination than in non-uveitic patients.

In the past many pediatric uveitic cataract patients were left aphakic after cataract extraction. However, in 1996 Probst and Holland reported successful IOL implantation in a small population of patients with JIA-associated uveitis [7]. Additional studies have validated this observation in small cohorts with varying caveats. Contact lens intolerance in the context of a need for ongoing topical corticosteroids, irregular ocular surface, and/or glaucoma drainage device associated bleb is a potential reason to favor IOL implantation, at least in certain cases. If an IOL is implanted, IOL biocompatibility is important to reduce inflammation. Heparin sulfate modified (HSM) PMMA and acrylic lenses are preferred over non-HSM PMMA and silicone lenses due to greater biocompatibility [8, 9]. Acrylic lenses typically are favored since they are less expensive, require a smaller wound, and are more widely available than HSM-PMMA IOLs.

Each case will be presented and followed by commentary from Dr. Areaux (regarding surgical and amblyopia management) and Dr. Armbrust (regarding uveitis control and appropriateness for IOL implantation).

Case 1

BI is a 12-year-old African female who presented with bilateral granulomatous anterior uveitis, active on topical corticosteroids, with secondary findings of bilateral posterior subcapsular cataracts, extensive bilateral posterior synechiae, and bilateral optic disc edema. Visual acuity with glasses was 20/25 right eye and 20/60

pinhole 20/25 left eye. Her history of joint pains in her back and hands raised suspicion for JIA, although examination with a pediatric rheumatologist was unremarkable. Infectious and inflammatory workup was normal including negative Quantiferon gold, RPR, Treponema antibody, Lyme Ab, Bartonella Ab, rheumatoid factor (RF), ACE, HLA-B27, anti-CCP, anti-SSA (Ro), CRP, and urinary beta-2 microglobulin. ESR was elevated (41, normal 0–15) and ANA was mildly elevated (1.8, normal <1.0). The patient was diagnosed with idiopathic chronic anterior uveitis.

The patient's age and her good best-corrected visual acuity alleviated concern for amblyopia development, and total control of uveitis was prioritized over cataract surgery. Oral corticosteroids and methotrexate were added to the topical corticosteroids, and adalimumab was added when uveitis recurred during systemic corticosteroid taper. Uveitis control and topical atropine were unsuccessful at lysing posterior synechiae. Additionally, the patient's clinical course was complicated by uveitic glaucoma with steroid-induced ocular hypertension, which was treated with maximal topical therapy of latanoprost, dorzolamide, timolol, and brimonidine, but elevated intraocular pressures persisted. Diamox was added for pressure control, and adalimumab was increased to weekly dosing in order to taper off oral prednisone. The uveitis was finally controlled (zero to trace cell in both eyes) off corticosteroids on weekly adalimumab and subcutaneous methotrexate 15 mg per week. The optic disc edema slowly resolved over the year following initiation of systemic uveitis treatment.

At this point, significantly reduced vision from cataracts (BCVA 20/100 OD, 20/70 OS) was impacting the patient's school performance and daily life. Combined cataract and glaucoma surgery were performed after inflammation had been controlled for 4 months. Posterior synechiolysis, cataract extraction, acrylic IOL (Alcon SN60WF) implantation, viscocanaloplasty, and circumferential trabeculotomy ab interno was performed on each eye 1 week apart. Inflammation was well-controlled with the following corticosteroid regimen: 1 mg/kg/day oral prednisone for 2 days prior to surgery, Solumedrol 1 mg/kg intraoperatively, a postoperative taper of oral prednisone over 12 days, and postoperative topical prednisolone acetate. After oral prednisone taper, anterior chamber inflammation was controlled on topical prednisolone acetate TID, weekly adalimumab, and 17.5 mg/week methotrexate. Although there was RNFL thickening as measured by OCT in the 3 months after surgery, the thickening was mild compared to presentation and it slowly returned to the patient's baseline. IOP normalized without medical therapy, despite chronic topical prednisolone acetate. BCVA was 20/20 in both eyes 7 months after surgery.

Comment (RGA) This case was challenging due to the dual threat of both cataracts and glaucoma in the setting of uveitis. Although the patient was not at risk for amblyopia, the need for maximal topical therapy and oral acetazolamide for IOP control raised the urgency. Gonioscopy was obviously key preoperatively and revealed angles with early uveitic changes but still amenable to surgery in both eyes by Spaeth grading: right eye was B-C 20f 1-2+PTM with fine scattered PAS and left eye was B 20f 1-2+PTM with fine scattered PAS. The option of simultaneous

glaucoma and cataract surgery was preferred by the patient and her family to optimize recovery time, but we discussed the possibility that excessive hemorrhaging during synechiolysis or trabeculotomy might obscure the view for additional surgery and require staging the procedures. Fortunately, this did not occur. In prepping the operating team for the case, iris hooks, intraocular scissors, and trypan blue were requested in addition to our usual equipment for lensectomy, anterior vitrectomy, and IOL implantation in a child. The patient and family were very reliable with excellent uveitis control preoperatively for 4 months, and sufficient support for an IOL was anticipated given that there had not been a prolonged course of uveitis. As such, an IOL implant was planned with the caveat to the family that intraoperative complications might preclude the placement of a lens. Direct gonioscopy lenses and the OMNI® (Sight Sciences, USA) combined viscocanaloplasty and trabeculotomy *ab interno* device was also requested. Despite posterior synechiae, the pupil was fairly mobile so preoperative dilation was planned, followed by cataract extraction and IOL implantation. Then Miochol was used to constrict the pupil and expose the angle, followed by *ab interno* angle surgery.

Intraoperatively through a clear corneal approach, trypan blue was used to improve visualization of the lens capsule at the start of the case and Healon GV was used to stabilize the lens for anterior capsulotomy. A cyclodialysis spatula was used to lyse numerous posterior synechiae (Fig. 21.1). In a bimanual approach, 20-gauge vitrectomy was used to fashion a 5 mm anterior capsulotomy. Irrigation and aspiration were used to remove the entirety of the cataractous lens without complication. Healon was used to fill the capsular bag and an SN60WF Alcon lens was injected into the bag. Healon was exchanged for BSS and the wounds were closed with 10-0 vicryl, leaving one untied for subsequent angle surgery (Fig. 21.2). Healon GV was used to deepen the nasal angle and central anterior chamber. The head was turned 45° in the opposite direction of the eye and the scope tilted 45° to align the plane of sight with the ipsilateral temple. A Swan-Jacobs lens was placed on the eye and the nasal angle was visualized clearly (Fig. 21.3). The OMNI® device needle was introduced into the anterior chamber and the nasal angle was engaged. A 360-degree viscocanaloplasty and subsequent trabeculotomy *ab interno* was completed. The hope (though there is no evidence currently) with this technique is that viscoelastic

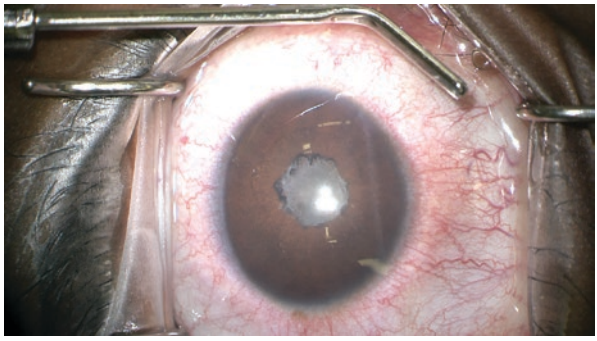

Fig. 21.1 Numerous posterior synechiae prior to lysis with a cyclodialysis spatula

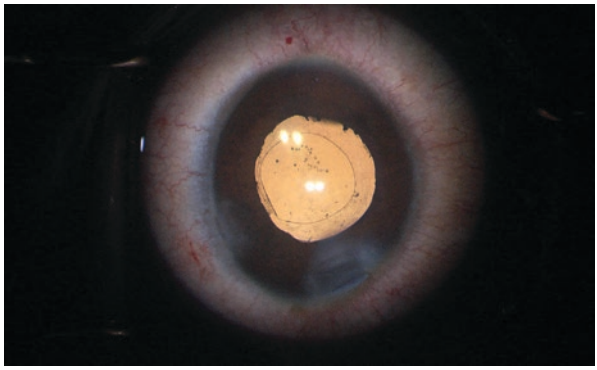

Fig. 21.2 Clear central axis after cataract extraction and IOL implantation

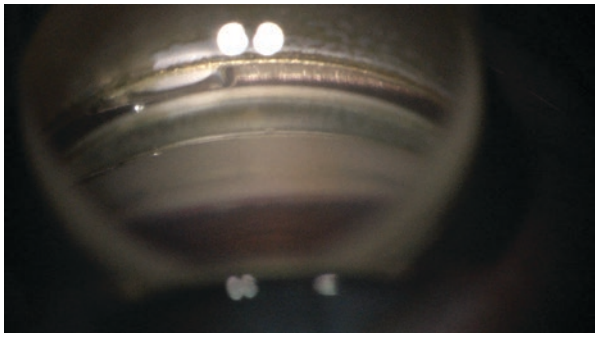

Fig. 21.3 Clear view of nasal angle as visualized using a Swan-Jacobs lens

may be advanced into the collector channels beyond the canal of Schlemm and improve outcomes compared to trabeculotomy alone in eyes with uveitic glaucoma by releasing scar tissue downstream of the trabecular meshwork similar to the way that goniosynechialysis works to release scarring in the angle in these patients. Healon GV was exchanged for BSS and the final wound was closed. 0.05 mL of Triesence followed by 0.1 mL of 50:50 Vigamox/BSS was injected into the anterior chamber at the end of the case. Maxitrol ointment and 1% atropine were placed on the eye followed by a light pressure patch and a shield. Postoperatively the IOP normalized without medications and the vision has been excellent. Corectopia, an artifact of preoperative uveitic iris ischemia, is visible superiorly in the slit lamp photo at 9 months postoperatively (Fig. 21.4).

Comment (KRA) This case illustrates the need for cooperation between ophthalmology and rheumatology to achieve sustained uveitis quiescence, which is the cornerstone for a successful ophthalmic outcome in severe, chronic, noninfectious uveitis. The ophthalmologist may start topical corticosteroids prior to obtaining results from an infectious evaluation, as long as the patient's presentation is more consistent with a noninfectious etiology. In this case, with bilateral granulomatous anterior uveitis and optic disc edema, the infectious workup should include testing for syphilis, tuberculosis, Lyme (in an endemic area or with suspected exposure),

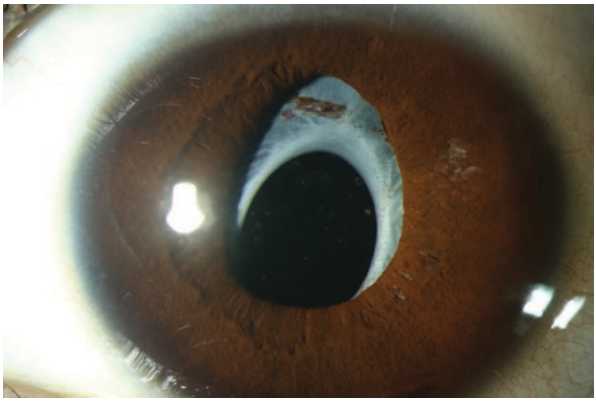

Fig. 21.4 Slit lamp photo showing corectopia superiorly at 9 months postoperatively

and bartonella. Then, as long as the infectious evaluation is negative, the ophthalmologist may add systemic corticosteroids depending on the severity of the uveitis and refer to a pediatric rheumatologist for management of systemic corticosteroid-sparing IMT. Historically, methotrexate has been the first-line IMT agent for many types of pediatric uveitis and remains an excellent choice for many pediatric patients. The newer anti-TNFα agents also are efficacious for uveitis and typically well-tolerated, but may require additional time and effort on the part of the rheumatologist for insurance approval. In a pediatric patient with severe noninfectious uveitis, letting the rheumatologist know at the time of initial consultation that starting methotrexate with likely need for addition of an anti-TNFα agent may facilitate timely approval of medications.

It is instructive to examine the response of posterior synechiae and uveitic optic disc edema to treatment in this case. Although posterior synechiae may lyse with uveitis control and cycloplegia, this type of treatment is more successful with newly formed synechiae. Chronic posterior synechiae often require surgical intervention, as in this case. Improvement and resolution of uveitic optic disc edema typically lags behind improvement in uveitis, and here the RNFL thickening on OCT continued to improve 6 months after the anterior uveitis became quiescent.

The relatively older age, good preoperative uveitis control without corticosteroids, and excellent patient and family compliance make IOL implantation in this case a good decision. IOL calculations are more accurate in older children, so delaying cataract surgery if feasible can be advantageous purely on a refractive basis. More importantly, if there is genuine concern that uveitis control will be difficult in the postoperative period, aphakia is preferred over IOL implantation. Therefore, the quality and duration of uveitis control, need for corticosteroids for uveitis control, and patient compliance all are important factors when considering IOL implantation.

This case is a good illustration of the inflammatory burden of surgery in pediatric patients with uveitis. In the early postoperative period it is critical to follow uveitis patients closely and promptly increase anti-inflammatory medications with any sign of inflammation, such as anterior chamber cell, posterior synechiae to the intraocular lens, optic disc edema, and cystoid macular edema. It also is important to expand

our surveillance later after surgery. In this case, despite excellent preoperative inflammatory control on systemic steroid-sparing immunosuppression for 4 months prior to surgery, increased uveitis persisted even after the typical postoperative period of 3 months. Seven months postoperatively, uveitis quiescence required increased methotrexate and addition of topical corticosteroids as compared to the patient's preoperative regimen. With close monitoring and adjustment of medications as needed, excellent uveitic and surgical outcome was achieved in this case.

Case 2

AL is a 9-year-old Asian male who presented with bilateral anterior and intermediate uveitis. Infectious workup was negative including Quantiferon gold, RPR, Treponema antibody, and Lyme antibodies. Inflammatory labs including CRP, ANA, cANCA, pANCA, ACE, and HLA-B27 were all normal. ESR was elevated. Evaluation by rheumatology revealed evidence of inflammatory arthritis involving the knee and TMJ (confirmed on MRI). The patient was diagnosed with JIA-associated anterior and intermediate uveitis. Treatment was initiated with topical corticosteroids (prednisolone acetate, then difluprednate), high-dose oral prednisone (started at 1 mg/kg/day), and methotrexate, and then adalimumab (every 2 weeks) was added 3 weeks later for persistent anterior chamber cell and vitreous haze despite high-dose systemic corticosteroid treatment. Methotrexate was slowly tapered upward to 20 mg/week, and the combination of methotrexate and adalimumab allowed total inflammation control by 6 months with successful wean off oral corticosteroids at 7 months and topical corticosteroids at 12 months. This patient's course was complicated by ocular hypertension prior to corticosteroid therapy as well as steroid-induced ocular hypertension that was treated with brinzolamide, timolol, latanoprost, and brimonidine.

At presentation there was mild nuclear sclerotic cataract of the left eye; 1 month later, posterior subcapsular cataract (PSC) of the left eye developed centrally, but uncorrected visual acuity remained excellent at 20/25+2 when all corticosteroids were stopped and uveitis was quiescent. Over the next 8 months, visual acuity remained stable, the uveitis was quiescent, and no corticosteroids were prescribed. However, in 2 months, the PSC rapidly became visually significant, with BCVA 20/200. The patient and family elected to proceed and cataract extraction with intraocular lens implant along with posterior synechiolysis. Perioperative steroid management included oral prednisone (0.5 mg/kg/day) 2 days prior to surgery, dexamethasone 4 mg intraoperatively, and a short oral prednisone taper postoperatively (0.5 mg/kg/day for 2 days, then tapered over 4 days).

After instillation of Healon GV, lysis of fairly extensive posterior synechiae was completed using an iris sweep and the significantly fibrotic pupil was stretched with a Kuglen hook (Fig. 21.5). Trypan blue was then instilled beneath the Healon GV and over the anterior capsule. Additional Healon GV was used to visco-dilate the pupil and stabilize the capsule. A cystotome was used to initiate and

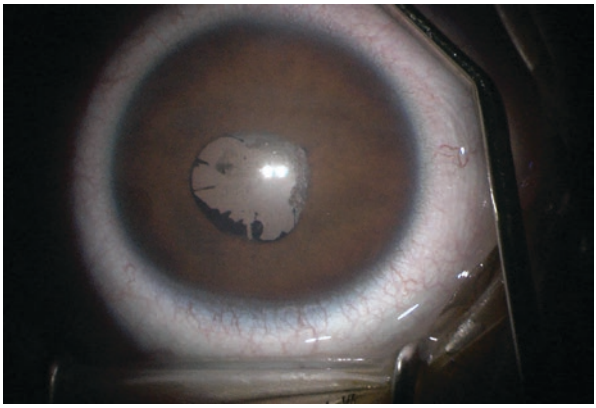

Fig. 21.5 Extensive posterior synechiae and PSC cataract

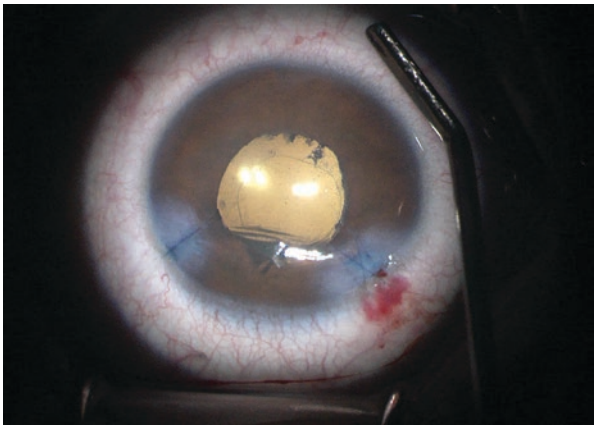

Fig. 21.6 Clear central axis after cataract extraction and IOL implantation

micro-capsulorhexis forceps were used to complete a continuous curvilinear capsulorhexis of 4.5 millimeters. In a bimanual approach, an irrigation handpiece and vitrector handpiece were used to remove the entirety of the cataractous lens without complication. Healon was used to fill the capsular bag, and an SN60WF Alcon lens was injected into the bag using the Monarch® delivery system. Healon was exchanged for BSS and the wounds were closed with 10-0 vicryl (Fig. 21.6). 0.05 milliliters of Triesence and 0.1 milliliters of Vigamox that had been diluted with sterile balanced salt solution in a 1:1 ratio were instilled into the anterior chamber at the end of the case. 1 drop of 1% atropine, apraclonidine, and timolol were placed on the eye followed by Maxitrol ophthalmic ointment, a light patch, and a shield.

Topical prednisone was increased to QID postoperatively and slowly tapered over 6 months based on anterior chamber cells. Six months postoperatively, the BCVA was 20/25 and the patient remained on topical prednisolone acetate 1% daily along with timolol and brinzolamide for IOP control. Six months later, despite aggressive utilization of perioperative systemic and topical steroids and a very slow ongoing taper of topical steroids, a posterior synechia that formed in the immediate postoperative period can be seen just below 9:00 (Fig. 21.7).

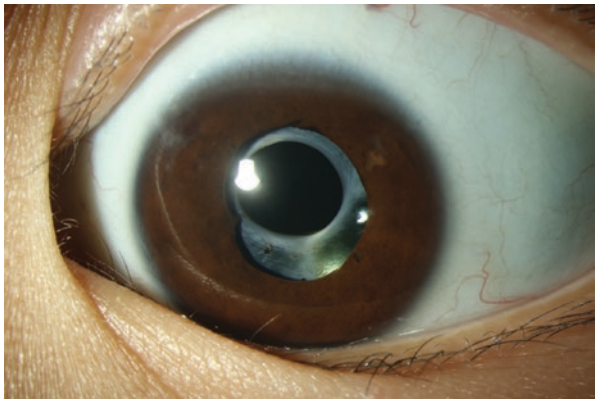

Fig. 21.7 A posterior synechia can be seen just below 9:00

Comment (*RGA)* Preoperatively there was debate as to whether simultaneous angle surgery was warranted to control IOP since we would already be in the eye and the higher efficacy of angle surgery in uveitic glaucoma early in the disease process. The IOP had spiked markedly with topical steroids implying a significant steroid response component and the family wished to minimize surgical risk. As a result, we agreed to exclusively cataract surgery with subsequent angle surgery if the IOP remained uncontrolled. Subsequent to surgery, the patient has been weaned to timolol daily and brinzolamide BID with excellent tolerance and IOP control in the teens. Further weaning of ocular hypotensives is planned. Thus, glaucoma surgery is not planned at this time.

The timeline to inflammation control merits discussion. It took 6 months to achieve control (zero to trace cell) of the uveitis. In a 9-year-old, the risk of amblyopia was essentially zero and the cataract did not become visually significant until 1 year after initial presentation. I have faced similar scenarios in younger patients, 4–5 years old, where aggressive topical and systemic immunomodulatory therapy for months result in improved but incompletely controlled inflammation and inadequate control for IOL implantation (at least 1+ active cell). In these scenarios, I have elected to intervene to remove the cataract with a posterior capsulotomy and anterior vitrectomy and leave the child aphakic with contact lens correction initiated within 1 week postoperatively. Aggressive amblyopia rehab with patching and bifocals can then be advanced while inflammation is further controlled. Secondary IOLs can be considered later with caution in the context of the level of inflammation control and the optimized visual potential.

Comment (KRA) The etiologic evaluation for anterior versus intermediate uveitis has substantial overlap but differs slightly. The first priority in any type of uveitis is to evaluate for infection. Syphilis should be ruled out in any type of uveitis. Lyme disease should be ruled out in both anterior and intermediate uveitis cases that are bilateral in an endemic area. Tuberculosis should be ruled out in granulomatous anterior uveitis, in any intermediate uveitis, and prior to systemic immunosuppression. In unilateral intermediate uveitis toxoplasmosis and toxocariasis should be

considered; these typically are diagnosed clinically but may require examination under anesthesia in the pediatric population. An elevated ESR is nonspecific but is helpful in raising suspicion for systemic inflammatory syndromes, such as JIA, TINU, and sarcoidosis. JIA-associated uveitis is typically anterior, but as in this case intermediate JIA-associated uveitis can occur. TINU also is more typical in anterior than in intermediate uveitis. Sarcoidosis should be a consideration with any type of uveitis. Intermediate uveitis has been associated with multiple sclerosis in studies of adult patients; however, multiple sclerosis-associated uveitis does not appear to be common in the pediatric population since no cases of multiple sclerosis were found in a series of pediatric intermediate uveitis patients [15]. A directed review of systems can help rule out multiple sclerosis symptoms, with a neurologic consultation and/or brain MRI to evaluate for white matter lesions if the review of systems is suspicious. Brain MRI to screen for multiple sclerosis in pediatric intermediate uveitis patients without neurological symptoms is not routinely performed. Again, this case illustrates the need for active collaboration between ophthalmology and rheumatology for appropriate systemic treatment, and in this case, rheumatologic evaluation also revealed the underlying etiology of JIA.

Uveitis and steroid-induced cataracts are significant complications in children with uveitis. Cataract surgery in pediatric patients with uveitis poses unique challenges. Excellent visual outcomes are possible with proper timing, perioperative optimization of inflammation control, and with the cooperation of a multidisciplinary team of pediatric ophthalmologists and rheumatologists. Published data on this topic is limited prompting the need for further research.

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