Long-term biocompatibility and visual outcomes of a hydrophilic acrylic intraocular lens in patients with uveitis

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PURPOSE: To report the long-term visual outcomes and biocompatibility of a single-piece hydrophilic acrylic intraocular lens (IOL) in patients with uveitis having cataract surgery.

SETTING: Tertiary referral center, Birmingham, United Kingdom.

DESIGN: Retrospective case review.

METHODS: The review included consecutive uveitis patients in whom phacoemulsification and acrylic IOL implantation was performed by the same surgeon. Outcomes measures are reported as rate/eye-year and included visual acuity and signs of bioincompatibility.

RESULTS: The review identified 171 eyes (140 patients; mean age 51 years [range 16 to 85 years]) with uveitis. The mean follow-up was 3.8 years (range 0.9 to 10.3 years). Signs of uveal bioincompatibility were found in 31 eyes, with visually insignificant deposits on the IOL in 17 eyes. The rate of uveal bioincompatibility was 0.06/eye-year. Signs of capsule bioincompatibility were found in 107 (63%) of 171 eyes (0.31/eye-year). Posterior capsule opacification was documented in 102 eyes (0.29/eye-year); neodymium:YAG laser capsulotomy was required in 31 eyes (0.05/eye-year). The rate of failure to maintain a 3 logMAR line improvement in corrected distance visual acuity (CDVA) was 0.08/eye-year; to maintain better than 0.3 logMAR, 0.15/eye-year; and to maintain either, 0.04/eye-year. At 1 year, 85% of eyes had a CDVA of better than 0.3 logMAR or maintained a 3 logMAR–line improvement. Eyes with preexisting macular or optic nerve disease had significantly worse visual outcomes.

CONCLUSIONS: The long-term safety profile of the hydrophilic acrylic IOL was good in uveitis cases, leading to good visual outcomes and a low rate of vision-impairing uveal and capsule complications.

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Cataract formation is a common complication of uveitis, causing up to 40% of visual loss in these patients.[1] Foster et al.[2] report success with extracapsular surgery and poly(methyl methacrylate) (PMMA) intraocular lens (IOL) implantation in uveitic patients, showing that IOL implantation is possible provided there is meticulous control of inflammation. The safety of phacoemulsification with IOL insertion has been clearly shown[3–7] and has become standard practice in uveitic patients.[8]

The modern surgeon is faced with a wide choice of IOLs, with 40 companies currently listed in the U.S. Food and Drug Administration database under the Intraocular Lens Classification.[A] This offers surgeons variations in architectural design, ease of delivery, and biomaterials with a range of mechanical and chemical properties. For cataract surgeons who treat eyes with inflammatory disease, IOL biocompatibility is critical when considering which IOL to implant, especially in patients with uveitis. Although the precise definition of biocompatibility remains undefined and the characteristics are dependent on the anatomic recipient site, it is recognized that the fundamental principle underpinning biocompatibility

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is the coexistence of synthetic material within a living tissue.[9] For the cataract surgeon, IOL biocompatibility is classified into uveal (the response of the uveal tract) and capsule (the response of residual lens epithelial cells), and biocompatibility is particularly relevant for IOL implantation in a patient with uveitis.

In this study, we evaluated the long-term visual outcomes of injectable single-piece, hydrophilic acrylic posterior chamber IOLs in patients with uveitis. The IOLs were composed of Rayacryl, a proprietary acrylic copolymer of 2-hydroxyethyl methacrylate and methyl methacrylate with ethylene glycol dimethacrylate as a crosslinking agent, rendering the surface hydrophilic; the material has a Young modulus of 3.0 MPa. Specific endpoints included postoperative visual improvement and signs of uveal and capsule bioincompatibility and whether the IOL was suited for implantation in eyes prone to intraocular inflammation.

PATIENTS AND METHODS

Study Population

Consecutive phacoemulsification cataract extractions in patients with uveitis were identified from surgical ledgers and/or electronic databases at Birmingham and Midland Eye Centre, Birmingham, United Kingdom, over a 10-year period between April 1999 and November 2008. Only procedures in which the single-piece Rayner acrylic IOL was implanted were included in this study.

Surgical Protocol and Technique

All eyes except those with Fuchs heterochromic cyclitis were required to be free of active inflammation for a minimum of 3 months before surgery. Two weeks before surgery, all patients except those with Fuchs heterochromic cyclitis were started on topical dexamethasone 0.1% 6 to 8 times per day or had the frequency of their existing topical corticosteroid increased to this frequency. Unless patients fell into a low-risk group, such as Fuchs heterochromic cyclitis or previous anterior uveitis with no posterior synechiae that had been quiescent for 5 or more years, a single pulse of 500 mg intravenous methylprednisolone was given at the time of surgery. Patients already taking oral corticosteroid and/or steroid-sparing oral immunosuppression were asked to continue the medications at their current dosage.

Surgery was performed by the same surgeon (P.I.M.) through a 2.8 mm clear corneal incision. Posterior synechiae were divided, and pupil stretching or insertion of iris retractors was performed when necessary. In cases with a high likelihood of postoperative posterior synechiae formation, such as extensive preoperative posterior synechiae or previous attacks of fibrinous uveitis with substantial anterior chamber flare, a prophylactic peripheral iridectomy was performed to prevent postoperative iris bombe. Subconjunctival betamethasone 4 mg and topical chloramphenicol 0.5% were given at the end of surgery. Postoperatively, all patients were prescribed topical dexamethasone 0.1% every 2 hours, cyclopentolate 1.0% once or twice daily, and chloramphenicol 0.5% 4 times daily for 2 weeks.

Follow-up

Patients were reviewed 1 day, 14 days, and 6 weeks postoperatively and then every 3 months thereafter over the first year of follow-up. Topical chloramphenicol was discontinued at 14 days, and the topical corticosteroid was decreased to the preoperative dosage by 6 months postoperatively. After the first year, the follow-up varied between 4 months and 9 months depending on the presence of intraocular inflammation.

Outcome Measures

Snellen visual acuity, uveal and capsule biocompatibility, and intraocular inflammation were graded at each follow-up visit. Preoperative pathology that would be expected to give a guarded outcome, such as optic neuropathy or irreversible macular pathology, was noted. Uveal biocompatibility was defined by the formation of posterior synechiae and the formation of deposits on the IOL, including a fibrinous membrane. Capsule biocompatibility was graded according to the development of posterior capsule opacification (PCO), development of anterior capsule phimosis, and whether a neodymium:YAG (Nd:YAG) laser posterior capsulotomy was performed. The latter was performed if there was a meaningful drop in subjective vision that normally corresponded to a loss of at least 10 logMAR letters or when there was difficulty in viewing the fundus. In both circumstances, the examining ophthalmologist (P.I.M.) was confident that PCO was the main cause. Neodymium:YAG laser posterior capsulotomy was only considered after a minimum of 6 months of follow-up and in eyes free of active uveitis for at least 2 months. Postoperative inflammation was defined as (1) mild flare; that is, a period of increased anterior chamber activity of 2+ or 3+ cells that necessitated an increase in treatment, or (2) severe/fibrinous uveitis; that is, an episode of inflammation with a hypopyon or fibrin visible in the anterior chamber occurring within 90 days of the procedure. The anatomic location of inflammation was described using the Standardization of Uveitis Nomenclature (SUN) classification.[10]

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Data and Statistical Analysis

Data are reported using Jabs' recommendations[11] for retrospective case series. Visual acuities were converted from Snellen to logMAR and are reported using a survival analysis, where survival is maintaining an improvement in visual acuity by 3 or more logMAR lines or a postoperative Snellen corrected distance visual acuity (CDVA) better than 6/12 (0.3 logMAR). Complications are reported as the rate occurring per eye-year of follow-up. To allow comparison between published data, some complications are reported as percentages at postoperative time points. Kaplan-Meier survival analysis, including log-rank correlation, was performed using Graphpad Prism for Macintosh OS X software (version 5.0b, Graphpad Software). To analyze data from patients in whom both eyes were operated on, generalized estimating equations were used and performed using PASW Statistics for Macintosh OS X software (version 18.0, IBM SPSS Software).

RESULTS

One hundred seventy-one eyes of 140 patients with uveitis had phacoemulsification and insertion of a Rayner hydrophilic acrylic IOL between April 1999 and October 2008. The mean follow-up was 3.8 years (median 3.2 years; range 0.9 to 10.3 years); the number of eye-years was 660. The mean age at the time of surgery was 51 years (range 16 to 85 years); 93 patients (66.43%) were women. Eighty-four patients were white, 45 were from the Indian subcontinent, 9 were African-Caribbean, and 2 were from Hong Kong. During the follow-up, 108 patients (136 eyes) failed to attend, moved out of the area, were discharged from the hospital, or died.

Table 1 shows the SUN anatomic classification and associated disease or syndrome of patients and eyes. Most patients had panuveitis, and an associated disease/syndrome could not be identified in many cases. Using generalized estimating equations, neither the SUN anatomic classification (excluding posterior uveitis due to small numbers) nor the associated disease (excluding diagnoses where n $\leq$ 5) were significantly related to capsule biocompatibility, uveal biocompatibility, PCO formation, Nd:YAG capsulotomy, postoperative cystoid macular edema (CME), postoperative inflammation, or postoperative visual acuity.

Table 1. The SUN anatomic classification and associated disease or syndrome for operated patients and eyes.

Parameter	Patients, n (%)	Eyes, n (%)
SUN anatomic classification		
Anterior	56 (40)	67 (39)
Intermediate	8 (6)	9 (5)
Posterior	5 (4)	5 (3)
Panuveitis	71 (51)	90 (53)
Associated disease/syndrome		
Idiopathic	74 (53)	98 (57)
Fuchs heterochromic cyclitis	22 (16)	22 (13)
Sarcoidosis	14 (10)	15 (9)
HLA-B27 associated	9 (6)	10 (6)
Behçet disease	5 (4)	6 (4)
Tuberculosis	4 (3)	6 (4)
Multiple sclerosis	3 (2)	5 (3)
Juvenile idiopathic arthritis	2 (1)	2 (1)
Sympathetic ophthalmitis	2 (1)	2 (1)
Acute retinal necrosis	1 (1)	1 (1)
Non-Hodgkin primary B-cell lymphoma	1 (1)	1 (1)
Cytomegalovirus anterior uveitis	1 (1)	1 (1)
Related to diabetes	1 (1)	1 (1)
Toxoplasmosis	1 (1)	1 (1)

HLA = human leukocyte antigen; SUN = Standardization of Uveitis Nomenclature

Visual Acuity

Figure 1 shows the Kaplan-Meier survival curves for all eyes. Snellen CDVA was 6/12 or better in 72 (70.59%) of 102 eyes at 6 months, 98 (61.25%) of 160 eyes at 1 year, and 64 (56.63%) of 113 eyes at 3 years;

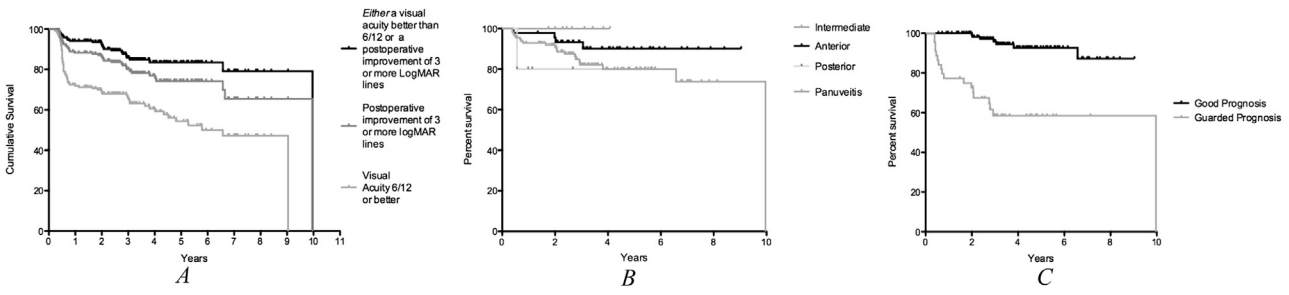

Figure 1. *A*: Survival curves for all eyes, with survival defined as an improvement in the CDVA by 3 or more logMAR lines and/or a postoperative CDVA better than Snellen 6/12. *B*: Survival curves for vision in all eyes grouped by the SUN anatomic classification. *C*: Survival curves for eyes with an expected good visual outcome and eyes with a guarded prognosis due to preexisting macular or optic nerve disease.

however, this included eyes with a guarded prognosis. One hundred thirty-eight eyes (86.25%) at 1 year and 96 eyes (84.96%) at 3 years met both criteria.

The overall rate of failure to maintain a 3 logMAR–line improvement in CDVA was 0.08/eye-year, the rate of failure to improve Snellen visual acuity better than 6/12 was 0.15/eye-year, and the rate of failure to achieve either was 0.04/eye-year. A guarded prognosis due to preexisting macular or optic nerve pathology was given for 44 (25.73%) of 171 eyes. Figure 1, *B*, shows the Kaplan-Meier curve for all eyes by anatomic classification; log-rank analysis found no significant difference between the groups. Figure 1, *C*, shows the Kaplan-Meier survival curves comparing eyes with a good prognosis for vision after surgery with those with a guarded prognosis due to preexisting optic nerve or macular pathology. Log-rank analysis showed these eyes did significantly worse than eyes with no guarded prognosis ($P < .0001$). When excluding eyes with preexisting optic nerve or macular pathology, the Snellen CDVA was better than 6/12 in 93 (78.15%) of 119 eyes at 1 year and 62 (73.81%) of 84 eyes at 3 years.

Uveal Biocompatibility

Signs of uveal bioincompatibility were found in 31 of 171 eyes; Figure 2 shows the Kaplan-Meier survival curve. The most common sign of uveal bioincompatibility was the formation of posterior synechiae, which occurred in 22 (12.87%) of 171 eyes and caused iris bombe in 3 eyes. Seventy-four of 171 eyes had preoperative posterior synechiae. Of these, 23 of 74 eyes developed posterior synechiae at any time postoperatively compared with 2 of 97 of eyes without preoperative posterior synechiae; the difference was statistically significant ($P < .001$). Deposits on the IOL occurred in 17 (9.94%) of 171 eyes, taking the form of giant cells in 7 eyes. In no eyes were these deposits thought to be of visual significance. The rate of uveal bioincompatibility was 0.06/eye-year. At 3 months, 6 months, and 1 year, 15 (8.77%) of 171 eyes, 18 (10.53%) of 171 eyes, and 23 (13.77%) of 167 eyes, respectively, showed signs of uveal bioincompatibility. Giant cells on the optic were found in 3 (1.80%) of 167 eyes at 1 year and 7 (4.09%) of 171 eyes at the final follow-up. The presence of signs of uveal bioincompatibility in an eye was significantly related to the number of intraoperative procedures performed ($P < .001$), with eyes requiring more intraoperative manipulation having a higher likelihood of subsequent signs of bioincompatibility.

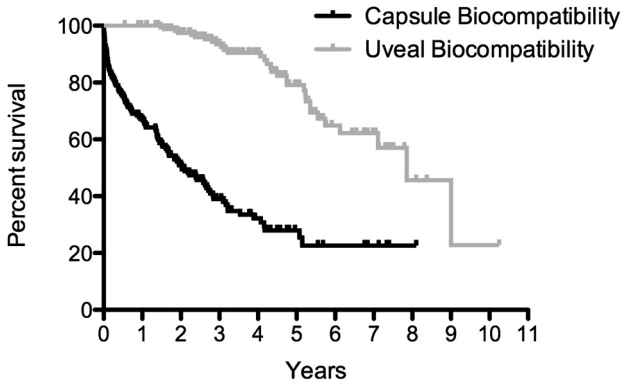

Figure 2. Survival curve showing eyes with signs of uveal and capsule biocompatibility.

Capsule Biocompatibility

Signs of capsule bioincompatibility were found in 107 (62.57%) of 171 eyes, occurring at a rate of 0.31/eye-year. At 3 months and 6 months, 32 (18.71%) of 171 eyes and 42 (24.56%) of 171 eyes, respectively, showed signs of capsule bioincompatibility. Figure 2 shows the Kaplan-Meier curve for capsule biocompatibility. Posterior capsule opacification occurred in 102 (59.65%) of 171 eyes, developing a mean of 15 months postoperatively and at a rate of 0.29/eye-year. At 3 months and 6 months, 29 (16.96%) of 171 eyes and 39 (22.81%) of 171 eyes, respectively, had PCO. Neodymium:YAG laser capsulotomy was performed in 31 (18.13%) of 171 eyes, with 2 eyes requiring more than 1 session to clear the visual axis. The mean and median time to Nd:YAG laser capsulotomy was 2.9 years and 2.3 years, respectively, and the rate of Nd:YAG laser capsulotomy was 0.05/eye-year. One (0.60%) of 167 eyes by 1 year and 12 (11.88%) of 101 eyes by 3 years had an Nd:YAG laser capsulotomy. Anterior capsule phimosis occurred in 7 (4.09%) of 171 eyes, at a rate of 0.01/eye-year, a mean of 1.2 years after surgery. Two eyes required treatment for the phimosis.

Intraoperative Procedures

Additional surgical steps were required in 110 (64.33%) of 171 operations, most commonly the division of posterior synechiae (72 operations). In 58 cases, a small pupil necessitated additional steps; iris retractors were used in 47 cases, pupil stretching in 14 cases, and pupil stretching and iris retractor placement in 3 cases. There were no posterior capsule tears in any eye.

Postoperative Inflammation, Endophthalmitis, and Cystoid Macular Edema

Mild flare-up of uveitis within 90 days of the surgery occurred in 11(6.43%) of 171 eyes after surgery. Severe flare occurred in 5 eyes (2.92%) between 1 day and 11

days (mean 8 days) postoperatively. Mild flare was treated with an increase in topical corticosteroid. Severe flare required intravenous methylprednisolone pulses or high-dose oral corticosteroid. No patient required the use of tissue plasminogen activator. There was no correlation between the preoperative use of intravenous methylprednisolone and mild flare-ups ($P = .83$) or fibrinous uveitis ($P = .54$) occurring within 90 days of surgery. Postoperative inflammation, whether mild flare-ups, severe inflammation, or both, were not correlated with uveal or capsule biocompatibility. One patient developed coagulase-negative staphylococcal endophthalmitis 3 days after surgery and was treated with an intravitreal antibiotic; the final CDVA was 0.18 logMAR. A second patient developed delayed endophthalmitis diagnosed 1 year following surgery by polymerase chain reaction from an anterior chamber tap demonstrating *Propionibacterium acnes* DNA. She had vitrectomy and intravitreal antibiotic injection; the final visual acuity was 0.18 logMAR.

Thirty-four of 171 eyes (19.88%) had a history of CME at any time before surgery. In 18 (10.53%) of 171 eyes, CME developed within 90 days of surgery and over the total follow-up period, CME developed in 26/171 (15.2%) eyes, with 3 eyes developing CME twice. The mean time to the onset of CME was 11 days (median 42 days; range 6 to 2610 days). The overall rate of CME development was 0.04/eye-year. In the majority of patients, CME was treated by a sub-Tenon triamcinolone injection. Other treatments included deep intramuscular methylprednisolone injection, intravitreal triamcinolone injection, intravenous methylprednisolone pulses, or high-dose oral corticosteroid.

Intraocular Lens Design

All IOLs implanted were single piece of the same material; however, over the study period, there were small alterations in their design. The 574H is a 4-plate haptic IOL; the other IOLs have 2 haptics. All IOLs have a square edge; however, the newer IOLs (570C, 970C, 620H, and 920H) have a proprietary Amon-Apple "enhanced" edge in which the square edge continues over the haptic–optic junction. A 570H IOL (Centerflex) was implanted in 73 eyes, a 570C IOL (C-flex) in 41 eyes, a 620H IOL (Superflex) in 25 eyes, a 574H IOL (Raysoft) IOL in 21 eyes, a 920H IOL (Superflex aspheric) in 10 eyes, and a 970C IOL (C-flex aspheric) in 1 eye. There were no statistically significant differences in uveal biocompatibility, capsule biocompatibility, Nd:YAG capsulotomy, or PCO survival curves between the IOL models. In addition, there was no significant difference in the survival curves for Nd:YAG capsulotomy or PCO between IOLs with the newer "enhanced" edges and those without.

DISCUSSION

Phacoemulsification with IOL implantation is now standard practice in uveitic eyes, with 97% of uveitis specialists favoring the technique[8] and numerous series[4–7] reporting good outcomes. All foldable IOLs are manufactured from a silicone elastomer or an acrylic polymer backbone. Side-chain alteration confers differing properties to the material, such as hydrophilicity or improved flexibility. In addition, surface modifications to the basic IOL material may render the surface of the IOL hydrophilic through heparin surface modification (HSM) or hydrophobic though surface passivation. The choice of IOL for all patients involves several factors; however, in patients with uveitis, the decision becomes more difficult. Breakdown of the blood–aqueous barrier in uveitis exposes the IOL to a different environment to that in healthy eyes in terms of the cellular composition,[12] cytokine profiles,[13,14] and protein content.[15]

Comparison of visual outcomes across published series is complicated by a lack of standardized reporting outcomes, the use of final visual acuity in series with variable follow-up, differences in patient populations and IOL designs, and preexisting visual morbidity. In our cohort, at 1 year 70% of patients had a CDVA better than 0.3 logMAR. In Foster et al.'s[2] original series, 87% of eyes that received an IOL achieved a Snellen CDVA of 20/40 or better. In our previously reported cohort,[5] we used a variety of IOLs; 75% had improved Snellen CDVA to within 20/30 after a mean follow-up of 17 months. Okrhavi et al.[16] found that 57% of patients had a Snellen CDVA of 6/12 or better at 6 months. Alio et al.[17] found that 46.3% of eyes had a Snellen CDVA of 20/40 or better at 1 year using a variety of IOL materials and designs. Because 26% of eyes in our study had a guarded prognosis before surgery, comparison with results in healthy eyes is difficult. Elgohary et al.[18] found that preoperative macular or optic nerve lesions were associated with poorer visual outcomes; this was confirmed in our cohort. Compared with the Snellen CDVA results in the Centerflex FDA study[19] using the same IOL material in healthy eyes, our results in our cohort of uveitic eyes were poorer, even when eyes with a guarded prognosis were excluded. In the Centerflex study, the Snellen CDVA was 6/12 in all eyes at 1 month and in 94% of eyes at 3 years compared with 78% and 73%, respectively, in our cohort.

Analysis of the biocompatibility of an IOL is made more difficult in patients with uveitis because postoperative inflammation may be due not only to factors

inherent in the IOL but also to an exaggerated response to surgical trauma or the underlying disease. The overall rate of uveal bioincompatibility was low in our series using a hydrophilic acrylic IOL. In a cohort with a 1-year follow-up, Alió et al.[17] found that eyes with silicone IOLs showed more signs of bioincompatibility, developing more posterior synechiae and giant cells on the optic. Although there were no hydrophilic acrylic IOLs in their series, the incidence of giant cells in our series is lower than for any of the IOLs they used. We previously failed to identify any case of giant-cell formation at 12 months with the hydrophilic acrylic H60M Hydroview (Storz),[5] although in this cohort there was no overall significant difference between the uveal biocompatibility of the silicone, hydrogel, or acrylic IOLs implanted. Tabbara et al.[20] also found no significant difference in uveal biocompatibility between a silicone and HSM PMMA IOL. In contrast, Abela-Formak et al.[21] found a higher number and rate of giant cells with a hydrophilic acrylic IOL than with a hydrophobic acrylic IOL.

Some studies found silicone IOLs to have good capsule biocompatibility in uveitic eyes,[22] while others report the opposite.[17] Elgohary et al.[18] and Papaliodis et al.[23] report the lowest Nd:YAG laser capsulotomy rate with silicone IOLs. Concerns remain with the use of silicone IOLs because of these IOLs' poorer compatibility with silicone oil in subsequent vitreoretinal surgery.[24] Although 102 eyes in our study had documented PCO, only 31 required laser capsulotomy because the patient noted a symptomatic decrease in vision or there was a limited view of the fundus. The majority of our patients with PCO were asymptomatic. The rate of Nd:YAG laser capsulotomy in our cohort (0.6% in the first year and 12% in the third year) compares well with the rate of Abela-Formak et al.,[22] who found a rate of 12% at 3 years using a square-edged hydrophilic acrylic IOL. Elgohary et al.[18] performed Nd:YAG laser capsulotomy in 33 (33%) of 101 eyes. Using 2 acrylic IOLs, Estafanous et al.[4] performed an Nd:YAG laser capsulotomy in 12 (31%) of 39 eyes. Rahman and Jones[25] report a final Nd:YAG laser capsulotomy rate of 53.5% using PMMA IOLs (HSM and non-HSM); although the mean follow-up in this cohort was longer than in ours, the mean time to Nd:YAG laser capsulotomy was similar. Suresh and Jones[7] found Nd:YAG laser capsulotomy rates were comparable between PMMA, HSM PMMA, and acrylic IOLs (20%, 26%, and 21%, respectively), although the follow-up in the acrylic group was much shorter than in the PMMA group. More recently, Roessel et al.[26] found no significant difference between the uveal and capsule biocompatibility of hydrophilic IOLs and hydrophobic acrylic IOLs, albeit with only 6 months of follow-up.

Surprisingly, our cohort has a lower Nd:YAG laser capsulotomy rate after the 1-year and 3-year follow-ups than the cohort in the Centerflex FDA study[19] (0.6% and 12% versus 7.8% and 29.41%). It is possible that fears of Nd:YAG laser–induced inflammation may cause reticence to perform the procedure in uveitic eyes. In addition, the time to Nd:YAG laser capsulotomy was relatively long (2.9 years). In our previous series,[5] the mean time to Nd:YAG laser capsulotomy was 16 months. Elgohary et al.[18] report a median time to Nd:YAG laser capsulotomy of 10.3 months, and Abela-Formak et al.[22] found the Nd:YAG laser rate increased into the third year of follow-up. This highlights the importance of adequate follow-up because the Nd:YAG laser rate may appear lower with a shorter follow-up.

Our study was limited by several factors common to many studies of uveitis. It was retrospective, there was no control group, and the patients represented a diverse group of disease in terms of disease severity and association. Our series, to our knowledge, represents the second largest cohort of patients with uveitis having modern cataract surgery and the largest using the same surgeon and a single IOL material. In addition, it is the first to report the use of Rayner hydrophilic IOLs in uveitis and the follow-up is among the longest reported. Another strength is that we used the SUN Working Group's recommendations for reporting clinical series,[10] which allows more meaningful comparisons with future published case series. A survey of members of the International Uveitis Study Group[8] showed that the majority use a hydrophobic acrylic IOL; however, only low-level evidence was quoted for this decision, with some surgeons asserting there was no available evidence to help guide the decision. This highlights the importance of disseminating all available evidence. A literature review is complicated by several factors, including the wide range of IOLs used, differences in surgical techniques, variable follow-up with data presented in a nonstandardized way, differences in reporting complications, and differences in reporting visual acuity. In addition, patients with uveitis are beset with the wide range of ocular and systemic disease and therapeutic regimens associated with that diagnosis. In our series, patients were enrolled in a standard stratified perioperative protocol, with surgery performed by the same surgeon. Although we recognize that case series do not provide the level of evidence of a randomized controlled trial, it is likely that the evidence regarding IOL use in uveitis will continue to depend on carefully performed clinical series.

WHAT WAS KNOWN

- Uveitis specialists believe there is insufficient evidence on which to base a decision on the type of IOL to implant in eyes with uveitis.
- The published data on patients with uveitis is, on the whole, derived from case series with variable follow-up reporting using final outcome measures, which makes statistical comparison difficult.

WHAT THIS PAPER ADDS

- This paper reports a cohort of uveitic eyes having modern cataract surgery. The study, to our knowledge, is the largest using a single IOL material and the largest by the same surgeon and had a long-term follow-up. This cohort therefore provides an excellent representation of the outcome of cataract surgery in patients with uveitis using a hydrophobic acrylic IOL.
- This paper is the first to report outcomes using complication rates and survival analysis, setting a benchmark for future case series.

REFERENCES

1. Durrani OM, Tehrani NN, Marr JE, Moradi P, Stavrou P, Murray PI. Degree, duration, and causes of visual loss in uveitis. Br J Ophthalmol 2004; 88:1159–1162. Available at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1772296/pdf/bjo08801159.pdf. Accessed October 15, 2013
2. Foster CS, Fong LP, Singh G. Cataract surgery and intraocular lens implantation in patients with uveitis. Ophthalmology 1989; 96:281–287; discussion by HJ Kaplan, 287–288
3. Kawaguchi T, Mochizuki M, Miyata K, Miyata N. Phacoemulsification cataract extraction and intraocular lens implantation in patients with uveitis. J Cataract Refract Surg 2007; 33:305–309
4. Estafanous MFG, Lowder CY, Meisler DM, Chauhan R. Phacoemulsification cataract extraction and posterior chamber lens implantation in patients with uveitis. Am J Ophthalmol 2001; 131:620–625
5. Rauz S, Stavrou P, Murray PI. Evaluation of foldable intraocular lenses in patients with uveitis. Ophthalmology 2000; 107:909–919
6. Süllü Y, Öge İ, Erkan D. The results of cataract extraction and intraocular lens implantation in patients with Behçet's disease. Acta Ophthalmol Scand 2000; 78:680–683. Available at: http://onlinelibrary.wiley.com/doi/10.1034/j.1600-0420.2000.078006680.x/pdf. Accessed October 15, 2013
7. Suresh PS, Jones NP. Phacoemulsification with intraocular lens implantation in patients with uveitis. Eye 2001; 15:621–628. Available at: http://www.nature.com/eye/journal/v15/n5/pdf/eye2001197a.pdf. Accessed October 15, 2013
8. Sreekantam S, Denniston AK, Murray PI. Survey of expert practice and perceptions of the supporting clinical evidence for the management of uveitis-related cataract and cystoid macular oedema. Ocular Immunol Inflamm 2011; 19:353–357
9. Williams D. The role of nitric oxide in biocompatibility. Med Device Technol 2008; 19:8; 10
10. The Standardization of Uveitis Nomenclature (SUN) Working Group. Standardization of uveitis nomenclature for reporting clinical data. Results of the First International Workshop. Am J Ophthalmol 2005; 140:509–516
11. Jabs DA. Improving the reporting of clinical case series [editorial]. Am J Ophthalmol 2005; 139:900–905
12. Khera TK, Copland DA, Boldison J, Lait PJP, Szymkowski DE, Dick AD, Nicholson LB. Tumour necrosis factor-mediated macrophage activation in the target organ is critical for clinical manifestation of uveitis. Clin Exp Immunol 2012; 168:165–177. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3390517/pdf/cei0168-0165.pdf. Accessed October 15, 2013
13. Hoekzema R, Murray PI, Kijlstra A. Cytokines and intraocular inflammation. Curr Eye Res 1990; 9(suppl):S207–S211
14. Curnow SJ, Falciani F, Durrani OM, Gemmy Cheung CM, Ross EJ, Wloka K, Rauz S, Wallace GR, Salmon M, Murray PI. Multiplex bead immunoassay analysis of aqueous humor reveals distinct cytokine profiles in uveitis. Invest Ophthalmol Vis Sci 2005; 46:4251–4259. Available at: http://www.iovs.org/cgi/reprint/46/11/4251. Accessed October 15, 2013
15. Forrester JV. Intermediate and posterior uveitis. Chem Immunol Allergy 2007; 92:228–243
16. Okhravi N, Lightman SL, Towler HMA. Assessment of visual outcome after cataract surgery in patients with uveitis. Ophthalmology 1999; 106:710–722
17. Alió JL, Chipont E, BenEzra D, Fakhry MA. International Ocular Inflammation Society Study Group of Uveitic Cataract Surgery. Comparative performance of intraocular lenses in eyes with cataract and uveitis. J Cataract Refract Surg 2002; 28:2096–2108
18. Elgohary MA, McCluskey PJ, Towler HMA, Okhravi N, Singh RP, Obikpo R, Lightman SS. Outcome of phacoemulsification in patients with uveitis. Br J Ophthalmol 2007; 91:916–921. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1955648/pdf/916.pdf. Accessed October 15, 2013
19. Becker KA, Martin M, Rabsilber TM, Entz BB, Reuland AJ, Auffarth GU. Prospective, non-randomised, long term clinical evaluation of a foldable hydrophilic single piece intraocular lens: results of the Centerflex FDA study. Br J Ophthalmol 2006; 90:971–974. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1857197/pdf/971.pdf. Accessed October 15, 2013
20. Tabbara KF, Al-Kaff AS, Al-Rajhi AA, Al-Mansouri SM, Badr IA, Chavis PS, Al-Omar OM. Heparin surface-modified intraocular lenses in patients with inactive uveitis or diabetes. Ophthalmology 1998; 105:843–845
21. Abela-Formanek C, Amon M, Schauersberger J, Schild G, Kolodjaschna J, Barisani-Asenbauer T, Kruger A. Uveal and capsular biocompatibility of 2 foldable acrylic intraocular lenses in patients with uveitis or pseudoexfoliation syndrome; comparison to a control group. J Cataract Refract Surg 2002; 28:1160–1172
22. Abela-Formanek C, Amon M, Kahraman G, Schauersberger J, Dunavoelgyi R. Biocompatibility of hydrophilic acrylic, hydrophobic acrylic, and silicone intraocular lenses in eyes with uveitis having cataract surgery: long-term follow-up. J Cataract Refract Surg 2011; 37:104–112
23. Papaliodis GN, Nguyen QD, Samson CM, Foster CS. Intraocular lens tolerance in surgery for cataracta complicata: assessment of four implant materials. Semin Ophthalmol 2002; 17:120–123
24. McLoone E, Mahon G, Archer D, Best R. Silicone oil-intraocular lens interaction: which lens to use? Br J Ophthalmol 2001; 85:543–545. Available at: http://www.ncbi.nlm.nih.gov/pmc/

articles/PMC1723969/pdf/v085p00543.pdf. Accessed October 15, 2013
25. Rahman I, Jones NP. Long-term results of cataract extraction with intraocular lens implantation in patients with uveitis. Eye 2005; 19:191–197. Available at: http://www.nature.com/eye/journal/v19/n2/pdf/6701450a.pdf. Accessed October 15, 2013
26. Roesel M, Heinz C, Heimes B, Koch JM, Heiligenhaus A. Uveal and capsular biocompatibility of two foldable acrylic intraocular lenses in patients with endogenous uveitis—a prospective randomized study. Graefes Arch Clin Exp Ophthalmol 2008; 246:1609–1615

OTHER CITED MATERIAL

A. U.S. Food and Drug Administration. Establishment Registration & Device Listing. Available at: http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfRL/rl.cfm. Accessed October 15, 2013