Phacoemulsification with intraocular lens implantation in patients with uveitis

PALANISAMY S. SURESH,
NICHOLAS P. JONES

CLINICAL STUDY

Abstract

Purpose **To investigate the safety and efficacy of phacoemulsification with intraocular lens implantation in eyes affected by uveitis.**
Methods **A retrospective case series is presented including casenote review and update patient examinations. Patient data were withdrawn from the Uveitis Clinic database. All uveitis patients undergoing phacoemulsification with intraocular lens implantation from August 1995 to November 2000 were included. A pre-operative preparation protocol was used. Operative and post-operative complications, degree of post-operative inflammation, best-corrected and final visual acuity were the main outcome measures.**
Results **Eighty-six eyes of 75 patients underwent surgery, which in 11 cases was combined with trabeculectomy. Mean follow-up was 24.1 months. Eight eyes (10%) had severe or fibrinous uveitis post-operatively. The mean delay between surgery and return to baseline treatment was 8.6 weeks. Posterior capsule opacification occurred in 42% of eyes and Nd-YAG capsulotomy was required in 21%. Cystoid macular oedema was seen in 2 eyes. Seventy-two per cent of eyes retain a visual acuity of 6/9 or better, and 87% of eyes retain a post-operative improvement of 2 or more lines of Snellen acuity.**
Conclusions **With careful patient selection, appropriate pre-operative preparation, diligent surgery and close post-operative supervision, phacoemulsification with intraocular lens implantation is safe and effective in the great majority of eyes with uveitis.**

Key words Cataract, Cataract extraction, Intraocular lens, Phacoemulsification, Uveitis

Cataract is a frequent complication of uveitis, being caused either by the inflammation or by the steroids used to treat it. Its management has always provided a challenge, being more difficult and less reliable in outcome than the management of age-related cataract. Many factors can contribute to this difficulty: band keratopathy and corneal deposits can render visibility poor; peripheral anterior and posterior synechiae, pupillary membranes and fibrosis can impair surgical access; and long-standing inflammation may compromise the integrity of capsule and zonule. Aggravation of inflammation in the post-operative period is the main concern and pre-operative uveitis has been found to be the most significant indicator of post-operative inflammation in eyes undergoing cataract surgery.[1] Such inflammation may lead to posterior synechiae and intraocular lens (IOL) capture, cellular deposition on the IOL, glaucoma, posterior capsule opacification, cystoid macular oedema, pupillary membrane formation, cyclodialysis and phthisis. There is an abundance of possible causes of visual loss before, during and after cataract surgery in patients with uveitis.

Rapid developments, both in surgical technique and in the understanding of the risk factors involved, have over the last 20 years substantially altered the approach to cataract surgery in uveitis.[2,3] With careful patient selection, rigorous pre- and post-operative control of inflammation and careful modern surgery, it now appears possible to obtain safer and more reliable outcomes. Several studies have documented the reliability of extracapsular surgery in uveitis.[1,4–10] but as yet evidence of the efficacy and safety of phacoemulsification in such eyes is sparse.[11–13] This study reports the results of phacoemulsification with IOL implantation performed by a single surgeon on a series of 86 eyes with uveitis and discusses a pre-operative preparation regime, surgical and post-operative complications and visual results.

Patients and methods

Details of all patients attending the Manchester Uveitis Clinic are entered onto a database, which records major medical and surgical treatment events. All patients with uveitis undergoing cataract surgery from August 1995 to November 2000 were identified, their medical records reviewed and data extracted including diagnosis, pre- and post-operative treatment

P.S. Suresh
N.P. Jones
Manchester Royal Eye Hospital
Manchester M13 9WH, UK

Mr N.P. Jones, FRCS, FRCOphth ✉
Manchester Royal Eye Hospital
Oxford Road
Manchester M13 9WH, UK
Tel: +44 (0)161 276 5628
Fax: +44 (0)161 272 6618
e-mail: njones@central.cmht.nwest.nhs.uk

Financial or proprietary interest: None

Received: 14 September 2000
Accepted in revised form: 10 April 2001

Table 1. *The Manchester Uveitis Clinic pre-operative preparation protocol*

Type of uveitis	Normal treatment	Pre-operative treatment
Quiescent anterior uveitis	Nil	Nil
Fuchs' heterochromic uveitis	Nil	G. Predforte ×6/day for 1 week
Chronic anterior uveitis	Topical steroid	Topical treatment enhanced to at least the above, with prednisolone 20–30 mg for 1 week in high-risk cases.
Chronic panuveitis – stable	Topical steroid + prednisolone	Topical treatment enhanced to at least the above. Prednisolone dosage usually unchanged
Chronic panuveitis – unstable	Topical steroid + prednisolone	Topical treatment enhanced to at least the above. Prednisolone dosages increased to at least 20 mg, or doubled, whichever is the higher dose

Patients also taking additional immunosuppression maintain the same dosage throughout.
Preparation may be modified if the patient is known to be a steroid 'responder'.

and inflammation levels, surgical details, complications and visual results. One of us (N.P.J.) performed all operations. The start date corresponded to the introduction, by this surgeon, of phacoemulsification surgery for patients with uveitis.

The Manchester Uveitis Clinic operates a pre-operative preparation protocol for patients with uveitis undergoing cataract surgery. Patients undergo surgery only when uveitis has been minimised and stabilised. No minimum period of stability is observed; while a period of 3 months or more is often desirable, some patients with fluctuating uveitis may undergo surgery during a perceived 'window of opportunity' when inflammation appears to be better controlled. All patients read an information pamphlet describing the major technicalities, limitations and possible complications of such surgery[14] and subsequently discuss their individual details with the surgeon prior to giving fully informed consent. Patients may be given additional anti-inflammatory treatment prior to surgery as described in Table 1. That approach may be modified if the patient has demonstrated raised intraocular pressure as a steroid response; in these cases a best compromise is reached. Concurrent immunosuppression is not altered during the surgical episode. Where patients were expecting bilateral cataract extraction, a significant period of post-operative stability in the first eye was observed before arranging second-eye surgery; although no minimum period was observed, this delay was usually several months.

Phacoemulsification surgery was performed via either a 5.5 mm scleral tunnel, or latterly a 3.2 mm keratome approach. Division of posterior synechiae, excision of pupillary membranes and mechanical pupil dilatation were performed where necessary. Iris hooks were inserted where pupil size remained unsatisfactory. Continuous circular capsulorrhexis and hydrodissection were followed by phacoemulsification or (frequently, reflecting the age of the patients) phacoaspiration. Following cortex removal, an IOL; (either 5.5 mm rigid one-piece polymethylmethacrylate (PMMA), or latterly foldable acrylic) was inserted. Closure was sutureless where possible. Sodium hyaluronate was used in all patients; particular care was taken to ensure its complete removal at the end of the procedure. All patients received a subconjunctival injection of betamethasone and antibiotic.

Post-operatively patients were supervised closely, with examinations on the first, fifth and twelfth post-operative days, with additional early examinations if necessary. Topical steroids were prescribed on a sliding scale according to the predicted severity of uveitis: eyes perceived to be at low risk of post-operative inflammation (including eyes with quiescent uveitis) received 6-hourly topical steroid; eyes with Fuchs' heterochromic uveitis (FHU) received 2-hourly topical steroid; and other eyes received a variable dose, up to a maximum of half-hourly administration. The dosages of topical and (where used) systemic steroid were reduced according to the observed post-operative recovery. The time at which post-operative medication returned to the pre-operative maintenance level was recorded. Mydriasis and cycloplegia were used as necessary.

Patients requiring Nd-YAG laser capsulotomy were commenced on, or enhanced their dose of topical steroid for several days before treatment and were monitored closely afterwards. Patients at high risk from raised intraocular pressure were given G. apraclonidine for several days following treatment.

Results

During the study period phacoemulsification with IOL implantation was performed on 86 eyes of 75 patients (35 male, 40 female). This represents 89% of all cataract surgery performed on uveitis patients during this period, other surgery comprising extracapsular cataract extraction with IOL implantation (8 eyes), lensectomy without IOL implantation (2 eyes) and vitreolensectomy (1 eye). The mean age at surgery was 43.8 years (range 19–89 years). The age distribution at surgery is shown separately in Fig. 1 for two groups of patients: those with FHU (showing a peak incidence in the late thirties) and those with other types of uveitis (showing a generally older age spread). The location and diagnosis of the uveitis are shown in Table 2.

Pre-operatively patients were managed according to the categories shown in Table 1. Four patients were considered to be in category 1 (3 with quiescent anterior uveitis, 1 with previous acute panuveitis). Of the 34 patients in category 2 (FHU) 28 received pre-operative steroid as indicated. The remainder, receiving no pre-operative medication, were either quiescent (5 patients) or a steroid 'responder' (1 patient). Twenty-eight patients

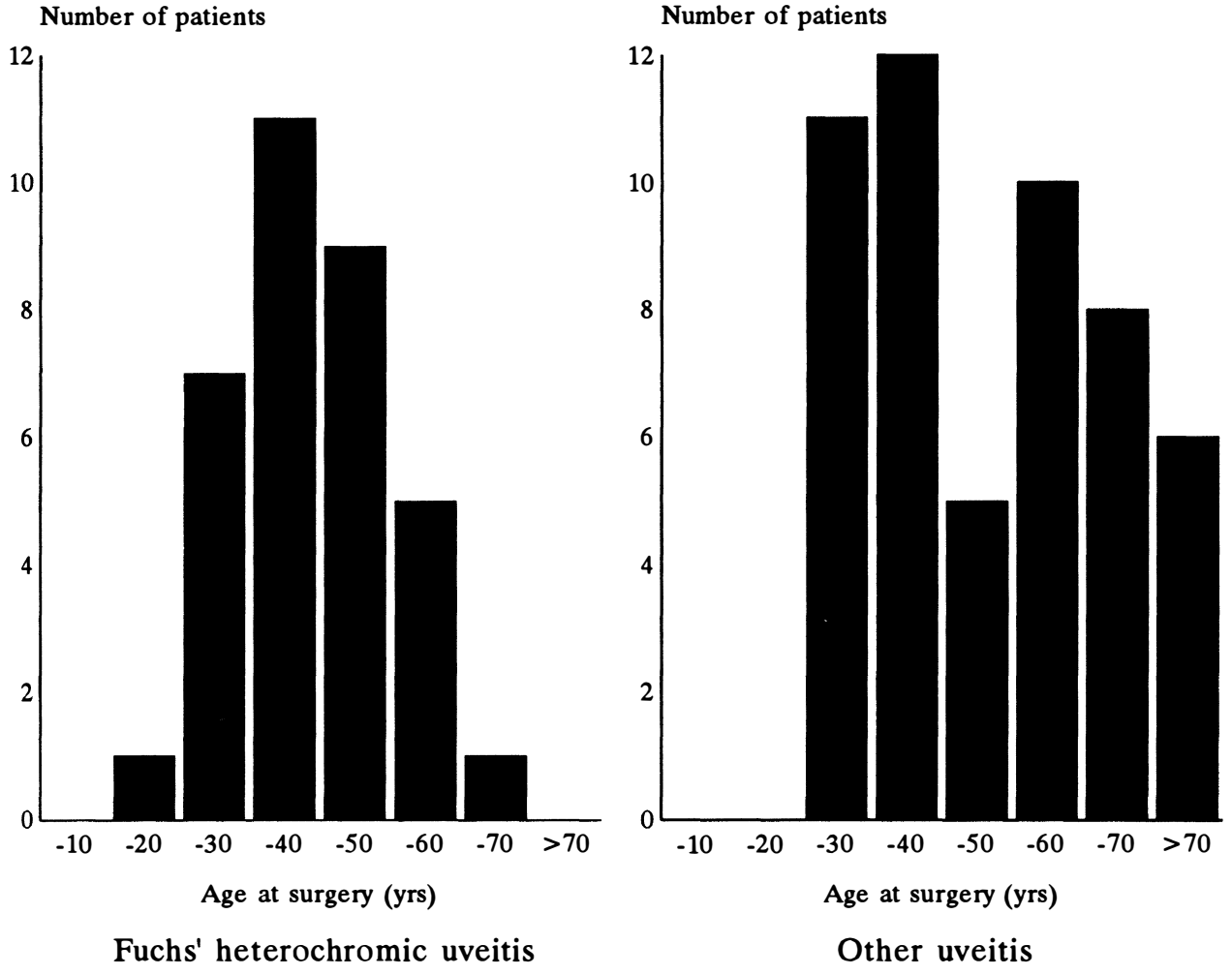

Fig. 1. *The age distribution at surgery for two groups: Fuchs' heterochromic uveitis and other forms of uveitis.*

were in category 3 (chronic anterior uveitis). Of these, 24 received an enhanced topical steroid dose (the remainder being steroid 'responders') and 5 commenced prednisolone (20–30 mg/day) for 1 week pre-operatively. Seven patients were considered to be in category 4 (requiring systemic steroid, but not at high risk of exacerbation) and did not receive an enhanced pre-operative systemic steroid dosage. Thirteen patients were in category 5 and used enhanced prednisolone (mode 20 mg/day) for 1 week pre-operatively. Four patients in category 5 were also using additional immunosuppression (1 cyclosporin, 1 azathioprine, 2 cyclosporin + azathioprine). These dosages were not altered peri-operatively.

Table 2. *The location and diagnosis of uveitis*

	AAU	CAU	INT	APU	CPU	Total
Behçet's disease					4	4
Candidiasis				1		1
Fuchs' heterochromic uveitis		34				34
HLA-B27 associated	1					1
Juvenile idiopathic arthritis		1				1
Masquerade (LGL leukaemia)					1	1
Psoriatic arthropathy		2				2
Sarcoidosis		3			4	7
Sclerouveitis		1				1
Sympathetic uveitis					1	1
Toxoplasmosis		1			2	3
Tuberculosis				1	1	2
Ulcerative colitis	1	1				2
Vogt-Koyanagi-Harada disease		1				1
Cause unknown	1	14	1	2	7	25
Totals	3	58	1	4	20	86

AAU, acute anterior uveitis (quiescent, no treatment); CAU, chronic anterior uveitis (on treatment); INT, intermediate uveitis; APU, acute posterior uveitis (quiescent, no treatment); CPU, chronic panuveitis (on treatment); LGL, large granular lymphocyte.

A 5.5 mm scleral tunnel approach was used in 49 eyes, and following a change in technique by the surgeon, corneal 3.2 mm keratome incision in 37 eyes. Posterior synechiae required division in 30 eyes and iris hooks were used in 32. A foldable acrylic IOL (Alcon Acrysof) was used in the most recent 25 eyes, a heparin surface-modified IOL (Pharmacia 812C, 728C) in 31 eyes and unmodified PMMA IOLs in the remaining 30 (19 of which had FHU).

In two instances the attempted capsulorrhexis was lost. In these cases phacoemulsification was nevertheless performed and a 7 mm rigid IOL implanted into the sulcus. In no instance was there a posterior capsule break, zonular dehiscence or vitreous loss. There were no

Table 3. *Location and intensity of pre-operative uveitis and type of surgery undergone, compared with post-operative uveitis intensity*

	Degree of post-operative anterior chamber cell activity				
	≤±	+	++	≥+++ and/or fibrin	Total
Location of uveitis					
Anterior uveitis (quiescent)	2	0	1	0	3
Chronic anterior uveitis (except FHU)	3	14	4	3	24
Fuchs' heterochromic uveitis	4	14	13	3	34
Intermediate uveitis	0	1	0	0	1
Acute panuveitis (quiescent)	3	1	0	0	4
Chronic panuveitis	2	11	5	2	20
Intensity of pre-operative uveitis					
0	7	17	9	7	40
±	7	12	9	0	28
+	0	12	4	1	17
++	0	0	1	0	1
Operation performed					
Phacoemulsification only	16	35	19	5	75
Phacoemulsification with trabeculectomy	1	3	4	3	11

other significant surgical mishaps, but intraocular haemorrhage (Amsler's sign) was observed in 20 eyes with FHU.

Pre-operatively 27 eyes were treated for glaucoma. Of these, 5 had already undergone trabeculectomy. An additional 11 eyes underwent trabeculectomy in combination with their phacoemulsification surgery. Of these 11 combined procedures, success in intraocular pressure control (IOP < 21 mmHg) was maintained in 9 eyes at latest follow-up. In 2 eyes receiving topical anti-glaucoma medication pre-operatively, control became more troublesome after cataract surgery, but neither has required trabeculectomy to date.

Pre-operatively 40 eyes had no anterior chamber (AC) activity, either quiescent (untreated) uveitis or completely controlled (treated) anterior uveitis. Twenty-eight eyes had AC cells ± or fewer and 18 eyes had AC cells + or more (13 with FHU, 4 with chronic panuveitis and 1 with chronic anterior uveitis). Post-operatively, 39 used topical steroids hourly or more in the first few days, 38 eyes 2-hourly and 9 eyes four times per day. The maximal post-operative uveitis was AC cells or less in 55 eyes, moderate (AC cells ++) in 23 eyes but severe (AC cells +++ or more, and/or fibrinous) in 8 eyes. The degree of post-operative uveitis in comparison with pre-operative uveitis location, intensity and type of surgery undergone is shown in Table 3. A total of 31 eyes developed moderate or severe (AC cells ++ or +++ or fibrin) post-operative uveitis. More than half of these were eyes with FHU. The proportion of eyes developing such uveitis were as follows: intermediate uveitis 0/1, quiescent panuveitis 0/4, quiescent anterior uveitis 1/3 (33%) chronic anterior uveitis 7/24 (29%), chronic panuveitis 7/20 (35%) and FHU 16/34 (47%).

Post-operative follow-up ranged from 4 to 63 months, with a mean of 24.1 months. For 80 of the 86 eyes the mean delay between surgery and return to 'baseline' (i.e. pre-operative maintenance) treatment was 8.6 weeks (range 2–31 weeks), but in the remaining 6 eyes (7%) return to baseline has not been achieved and enhanced treatment is likely to be necessary in the long term.

Post-operatively hyphaema was seen in 4 eyes. All were eyes with FHU where Amsler's sign had been noted at surgery. All resolved rapidly but in 2 eyes raised intraocular pressure was found, 1 eye requiring continuing topical medication. Clinical cystoid macular oedema developed in 2 eyes. In 2 eyes (both with FHU) iris capture occurred, forming synechiae to the posterior capsule behind the IOL, leading to chronic inflammation and giant cell deposition on the IOL. Both patients are using topical steroid maintenance to control this inflammation.

Giant cell deposition on the IOL surface was substantial enough to initiate or enhance topical steroid treatment in 16 eyes (19%), occurring on 7 of 31 heparin surface-modified IOLs (23%), on 3 of 25 acrylic IOLs (12%) and on 6 of 30 PMMA IOLs (20%). Of the 16 eyes showing giant cell deposition, 11 had FHU, 2 had chronic anterior uveitis, 2 had chronic panuveitis and 1 had quiescent AAU.

Posterior capsule opacification was seen in 36 eyes (42%), occurring behind 16 of 30 PMMA IOLs (53%) of which 9 (30%) have undergone Nd-YAG capsulotomy (mean follow-up period 27.5 months); behind 14 of 31 heparin surface-modified IOLs (45%) of which 8 (26%) have undergone Nd-YAG capsulotomy (mean follow-up 36.8 months); and behind of 6 of 25 acrylic IOLs (24%) of which 1 (4%) has undergone Nd-YAG capsulotomy (mean follow-up 14.8 months). In total 18 eyes (21%) have so far undergone Nd-YAG laser capsulotomy. No eye developed a flare-up of uveitis, glaucoma or cystoid macular oedema following these treatments.

Clinically observed cystoid macular oedema (CMO) developed in only 2 eyes during their post-operative follow-up period. One patient had psoriatic arthropathy-associated uveitis and the other, chronic uveitis following retinal toxoplasmosis. Neither eye had developed CMO pre-operatively. In a further 8 patients (undergoing surgery to 12 eyes) CMO in all 12 eyes had required treatment at some stage in the course of their disease pre-operatively. In 11 of these eyes, the CMO had been removed by treatment and did not recur post-operatively. In the twelfth eye, subtle CMO was persistent pre-operatively but did not worsen post-

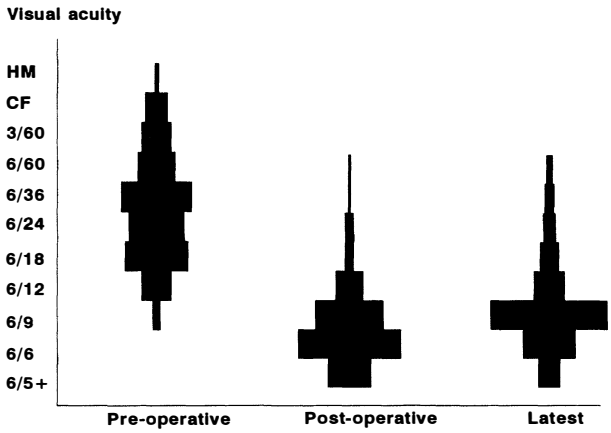

Fig. 2. *The distribution of Snellen visual acuities at three stages: immediately before surgery (pre-operative, mode = 6/36, 19 patients), post-operative (mode = 6/6, 33 patients) and at the latest follow-up visit (mode = 6/9, 38 patients).*

operatively. These eyes included 5 with idiopathic chronic panuveitis, 4 with Behçet's disease, and 1 each with sympathetic uveitis, psoriatic arthropathy with chronic anterior uveitis, and intermediate uveitis.

Fig. 2 shows the best-corrected visual acuity (VA) distribution in patients pre-operatively, post-operatively and at the latest follow-up visit. The mode VA for each group is: pre-operative 6/36 (19 patients), post-operative 6/6 (33 patients) and latest 6/9 (38 patients). Overall an immediate improvement of 2 or more lines of Snellen VA was seen in 78 eyes (91%) and at latest follow-up this improvement level was maintained in 76 eyes (87%). Seventy-two eyes (84%) have a latest VA $\geqslant$ 6/12. The remaining 14 eyes have a latest VA worse than 6/12, including the 2 eyes whose VA is worse than pre-operatively. The details of these patients and the cause of their sub-optimal VA are given in Table 4.

Discussion

Previous studies have investigated the safety of extracapsular cataract surgery in uveitis in general[2–12] and in specific uveitis entities.[15–18] However, it is clear to the experienced cataract surgeon that straightforward phacoemulsification with IOL implantation is less traumatic than straightforward extracapsular surgery. The entry wound is smaller, the intraocular pressure and anterior chamber are under better control, the iris is usually undisturbed by lens removal and endocapsular placement of the IOL is guaranteed. The breakdown of the blood–ocular barrier following extracapsular surgery is well documented,[19] but even though that breakdown may be long-lasting even for small-incision surgery,[20] the effect appears substantially less for phacoemulsification than for extracapsular surgery in non-compromised eyes.[21–23] It is therefore reasonable to pursue phacoemulsification with IOL implantation as the preferred technique in patients with uveitis, if risks intrinsic to that surgery are not greater than for extracapsular extraction. The reliability of endocapsular fixation, preventing iris touch, seems to be an important component of this form of surgery, though it has been suggested that in some eyes, in order to prevent synechiae between iris and posterior capsule, sulcus fixation of a large-optic IOL might be preferable.[24] This complication occurred in only 2 of 86 eyes in this series. There is a potential risk of increased post-operative inflammation induced by IOL–iris touch with large sulcus-fixated IOLs in patients with uveitis. This risk, and the low incidence of iris capture from small IOLs, suggests to us that endocapsular fixation of small-optic IOLs is the method of choice.

If significant capsule disruption occurs during surgery in patients with uveitis, preventing endocapsular or sulcus IOL implantation, the use of an anterior chamber IOL is likely to be unsafe and sutured posterior chamber IOLs are of unproven safety in these eyes. The maintenance of capsule integrity in these predominantly young patients, often with difficult surgical access, is therefore of paramount importance. We recommend that such surgery is undertaken (as in this single-surgeon series) by surgeons experienced in these techniques.

Post-operative exacerbation of uveitis is a clear risk in eyes with uveitis. Despite our pre-operative management regime 31 eyes developed moderate or severe uveitis (AC

Table 4. *Data on the 14 patients with a latest visual acuity worse than 6/12*

		Visual acuity			
Patient age, sex	Diagnosis	Pre	Post	Latest	Reason for visual acuity <6/12
43M	FHU	6/24	6/18	6/18	Amblyopia
31M	FHU	6/60	6/60	6/60	Amblyopia
35F[a]	FHU	6/18	6/12	6/36	IOL cell deposits ++, vitreous opacities
38M	FHU	6/60	6/18	6/24	Amblyopia, nystagmus, high myopia
48M	FHU	6/36	6/36	6/36	Macular scar, presumed toxoplasmosis
57M	FHU	6/24	6/12	6/24	Amblyopia, glaucoma field loss
61M	Toxoplasmosis	6/60	6/12	6/18	Old cystoid macular oedema
19M	Behçet's	6/60	6/24	6/36	Epiretinal membrane
51F	Sarcoidosis	CF	6/24	6/24	Macular scar – old choroiditis
55F	Sarcoidosis	6/60	6/12	6/18	Epiretinal membrane
67F[a]	Idiopathic CPU	6/12	6/9	6/18	PCO, flare-up of panuveitis
		6/60	6/6	6/18	PCO, flare-up of panuveitis
37F	Psoriatic	6/60	6/24	6/24	Post-operative cystoid macular oedema
35F	Behçet's	CF	6/8	6/18	Macular scar – old retinitis

Pre, pre-operative; post, post-operative; FHU, Fuchs' heterochromic uveitis; CPU, chronic panuveitis; PCO, posterior capsule opacification.
[a]Patients with a deterioration from the pre-operative visual acuity

Table 5. *A comparison of morbidity and outcomes between Fuchs' heterochromic uveitis (FHU) and other forms of uveitis*

	FHU 34 (40%)	Other active 46 (54%)	Other quiescent 6 (7%)
Pre-existing co-morbidity			
Macular scar	1 (3%)	12 (26%)	0
Amblyopia	3 (9%)	0	0
Glaucoma	8 (23%)	18 (39%)	1 (17%)
(previous trabeculectomy)	2 (6%)	7 (15%)	0
At surgery			
Intraocular bleeding (Amsler)	20 (59%)	0	0
Combined with trabeculectomy	4 (12%)	7 (15.5%)	0
Lost capsulorrhexis	0	2 (4.3%)	0
Other complications	0	0	0
Post-operative complications:			
Postoperative uveitis ⩾++, fibrin	16 (47%)	14 (31%)	1 (17%)
Giant cell deposition on IOL	12 (35%)	4 (9%)	1 (17%)
Posterior capsule opacification	18 (53%)	14 (31%)	2 (33%)
(Nd-YAG capsulotomy)	7 (20%)	8 (18%)	2 (33%)
Iris/IOL incarceration	2 (6%)	0	0
Cystoid macular oedema	0	2 (4.3%)	0
Visual result			
Post-operative visual acuity ⩾ 6/9	27 (79%)	38 (83%)	6 (100%)
Latest visual acuity ⩾ 6/9	25 (74%)	33 (73%)	6 (100%)

cells ⩾ ++ or fibrin), though all were rapidly controlled by enhanced medication. The incidence of this problem was highest for eyes with FHU. We postulate that this is associated with the increased intraocular vascular fragility which is a feature of this disease.

There is a commonly held view that eyes with heterochromic uveitis undergoing cataract surgery are likely to behave as eyes without uveitis, with a low risk of post-operative uveitis. Both this series and a previous study by one of us[6] provide evidence that this is not the case, and indeed that the opposite may be true. Table 5 shows a comparison between some manifestations of eyes with FHU in comparison with other eyes in this series. There is a reported high incidence of pre-existing amblyopia in eyes with FHU[25] and a generally accepted glaucoma incidence of about one-quarter. Intraocular bleeding at surgery was virtually universal with the extracapsular technique,[18] whereas the reduced pressure differentials of closed surgery reduce the incidence to a mere 59% in this series; in contrast intraocular haemorrhage and post-operative hyphaema is rare in other eyes with uveitis. In addition, both giant cell deposition on the IOL and posterior capsule opacification appear to be more common in eyes with FHU. In conclusion, these eyes may have a somewhat different spectrum of complications from other eyes with uveitis, but these complications are no less important and indeed may be more troublesome. The visual outcome is not significantly better in this series from that achieved in other forms of uveitis. The myth that FHU eyes are per-operatively straightforward, should be dispelled.

The complete suppression of uveitis pre-operatively has been considered an essential component of successful cataract surgery in uveitis,[2–4] contributing to modern success rates. The pre-operative treatment regime summarised in Table 1 has evolved from experience in this clinic. With the exception of patients with quiescent uveitis most patients receive enhanced topical steroid treatment for 1 week pre-operatively, including those with FHU. An important exception is those known to be steroid 'responders'. Some patients with chronic anterior uveitis considered at high risk (usually because of the presence of significant flare) receive systemic steroid for 1 week. Enhanced systemic steroid (at least 20 mg/day for 1 week pre-operatively) is also used for those with panuveitis considered at risk of post-operative flare-up. We believe that this approach, tailored to our impression of the severity and likely behaviour of the uveitis in individual cases, has contributed to the low incidence of post-operative complications in this series. It should be noted that our protocol aims to minimise inflammation but may not completely eliminate it; we consider that the additional steps sometimes undertaken to achieve this final 'push' for quiescence are usually unhelpful except in the highest-risk eyes, and in some eyes the aim cannot be achieved. As evidenced by data in this series, we believe that in eyes with minimised and stabilised inflammation, surgery can be performed safely. A total of 8 eyes developed severe (AC cells +++) or fibrinous uveitis post-operatively. Of these, 7 had no AC activity pre-operatively and all 8 eyes have a VA of ⩾ 6/12 at latest follow-up. Of all 40 eyes with no AC cells pre-operatively, 16 (40%) developed AC cells ++, +++ or fibrin post-operatively. For 28 eyes with AC cells ± pre-operatively this figure was 9 (32%) and for 17 eyes with cells +, 5 (29%). Even severe post-operative uveitis was short-lived in these eyes, and this appears to have little or no correlation with the degree of pre-operative control of uveitis (within these limits) or with the eventual visual result. The early studies recommending complete elimination of pre-operative uveitis before cataract surgery were based upon eyes undergoing extracapsular surgery. We postulate that the lesser ocular insult of small-incision phacoemulsification surgery may explain, at least in large part, the apparently reduced importance of such an approach. Nevertheless we stress that we do not have a *laissez-faire* approach to the pre-operative control of inflammation – on the contrary, treatment is optimised and is aggressive where required.

In patients with uveitis requiring cataract surgery who also have secondary glaucoma, combined surgery may be considered. In this series 27 eyes (31%) had secondary glaucoma and 5 had previously undergone (successful) trabeculectomy. Of the remaining 22 patients receiving topical glaucoma medication, a decision was made to combine cataract surgery with enhanced trabeculectomy in 11. Of these 11 procedures, 7 were followed by moderate or severe (AC cells ⩾ +++) post-operative uveitis, including 3 eyes with fibrinous uveitis. Nevertheless no long-term complications ensued and the

trabeculectomy was successful in 9 of 11 eyes, the 2 failures being late in follow-up. It appears that combined cataract and glaucoma drainage surgery gives an increased risk of post-operative uveitis in comparison with cataract surgery alone, and this risk should be taken into consideration when planning such surgery.

The safety of IOL implantation in patients with uveitis is not universally accepted, the interaction between materials and uvea and the tendency to cause inflammation being well reported,[26,27] but it is increasingly clear that with adequate preparation, the great majority of eyes can tolerate IOL implantation. The optimal IOL type for such eyes is unclear. Although some evidence suggested that heparin surface-modified IOLs were advantageous for uveitic eyes undergoing extracapsular surgery[28,29] it is less likely that IOL material is of significance where IOL fixation is endocapsular.

There is one important exception to the general acceptability of IOL implantation in eyes with uveitis. Most ophthalmologists treating patients with uveitis related to juvenile idiopathic arthritis (JIA) would regard these eyes as qualitatively different from other eyes with uveitis. In particular the poor response to cataract surgery has been noteworthy and, until recently, the overwhelming view was that vitreolensectomy without IOL implantation was the only safe choice of procedure.[31] However, even these eyes, if carefully selected in older children or young adults, appear able to tolerate phacoemulsification and IOL implantation.[32] This series contains only one adult with JIA and uveitis. The patient had undergone, some 5 years previously, a vitreolensectomy with a poor visual result occasioned by intractable macular oedema and pre-existing amblyopia. In the context of well-controlled but minimally active uveitis (importantly, with negligible flare) she underwent phacoemulsification with IOL implantation in the second eye at the age of 30 years. Despite post-operative short-lived fibrinous uveitis, the visual acuity remains high and the uveitis under good control 3 years post-operatively.

Posterior capsule opacification (PCO) after cataract surgery is common, but it appears to be more common in patients with uveitis. Dana and colleagues[33] found that 56% of patients with uveitis developed PCO in comparison with 40% of controls, but when corrected for age (the uveitis patients being younger) it was unclear whether uveitis was a separate risk factor. In this series with a mean age of 43.8 years at surgery, over 40% of eyes developed PCO. In 18 cases Nd-YAG capsulotomy has been performed. This PCO rate is consistent with previous reports. In view of concerns about the safety of Nd-YAG capsulotomy in uveitis patients, the criteria for treatment are different in this group. We have treated 17 of 36 eyes, whereas in eyes without uveitis, undoubtedly a greater proportion would have undergone treatment. However, using our techniques as described, no patient in this series encountered a significant complication following Nd-YAG capsulotomy, and in particular there were no episodes of clinically apparent macular oedema or decreased vision. It has been suggested that primary posterior capsulorrhexis may be an alternative in these patients,[12] but further evidence on relative risk is clearly necessary.

In young patients with uveitis, the use of acrylic IOLs with their apparent protective effect against PCO[30] is of clear theoretical benefit. Statistical comparison can not be made in this series as follow-up periods for eyes receiving acrylic IOLs is shorter than for other IOLs. However, promising trends are apparent: the PCO rate for acrylic IOLs, at 24%, is half that for other IOL types (47.5%), and although the rate of Nd-YAG capsulotomy is 26.2% for other IOL types, it is currently 4% for acrylic IOLs. There is no evidence from this or another[13] study that foldable acrylic IOLs are contraindicated in eyes with uveitis, and they are currently our IOL of choice.

In this series of 86 eyes, clinical CMO developed post-operatively in only 2 eyes (2%). This is a low incidence in comparison with other series. Neither eye had shown CMO pre-operatively, and in contrast CMO did not recur post-operatively in 12 eyes which had shown CMO at some stage before surgery. It may be thought that the low incidence of post-operative CMO in this series could reflect the casemix, in particular the fact that only 1 patient with intermediate uveitis, but 34 with FHU, underwent surgery during the study period; however, retrieval of data from the Manchester Uveitis Clinic database shows that for the diagnoses represented within these 86 eyes, the following rates of CMO (unassociated with surgery) have been observed, in descending order: sympathetic uveitis 47% (sample 15 patients); chronic panuveitis 37% (133 patients); acute panuveitis 36% (25 patients); intermediate uveitis 34% (123 patients); chronic anterior uveitis 14% (169 patients); quiescent acute anterior uveitis 8% (118 patients); and FHU 0.5% (179 patients). It seems that casemix alone cannot explain the low post-operative incidence of CMO, which we attribute to good peri-operative control and atraumatic surgery.

Post-operative CMO appears to be a particularly low risk for FHU patients; indeed is a low risk at any time in this disease. One of us (N.P.J.) has now reported personal experience of 84 FHU eyes undergoing extracapsular or phacoemulsification cataract surgery,[6,29] with 1 mild episode of CMO, and a previous review[18] showed a total of 284 published cases with only 2 reported instances (0.7%). The reasons for this substantially smaller risk of CMO in FHU patients are unclear.

In conclusion, this study demonstrates that with careful patient selection, thoughtful pre-operative preparation and diligent surgical technique, phacoemulsification with endocapsular IOL implantation is suitable for patients with uveitis, with the exception of very high-risk cases. Despite the expected complications of post-operative uveitis, posterior capsule opacification and cystoid macular oedema, the incidence of worsened vision is very small, the great majority of patients regaining and retaining a high visual acuity.

References

1. Heger H, Drolsum L, Haaskjold E. Cataract surgery with implantation of IOL in patients with uveitis. Acta Ophthalmol 1994;72:478–82.
2. Hooper PL, Rao NA, Smith RE. Cataract extraction in uveitis patients. Surv Ophthalmol 1990;35:120–44.
3. Rojas B, Foster CS. Cataract surgery in patients with uveitis. Curr Opin Ophthalmol 1996;7:11–6.
4. Foster CS, Fong LP, Singh G. Cataract surgery and intraocular lens implantation in patients with uveitis. Ophthalmology 1989;96:281–8.
5. Chung YM, Yeh TS. Intraocular lens implantation following extracapsular cataract extraction in uveitis. Ophthalmic Surg 1990;21:272–6.
6. Jones NP. Extracapsular surgery with and without intraocular lens implantation in Fuchs' heterochromic uveitis. Eye 1990;4:145–50.
7. Foster RE, Lowder CY, Meisler DM, Zakov ZN. Extracapsular cataract extraction and posterior chamber lens implantation in uveitis patients. Ophthalmology 1992;99:1234–41.
8. Tessler HH, Farber MD. Intraocular lens implantation versus no intraocular lens implantation in patients with chronic iridocyclitis and pars planitis: a randomised prospective study. Ophthalmology 1993;100:1206–9.
9. O'Neill D, Murray PI, Patel BC, Hamilton AMP. Extracapsular cataract surgery with and without intraocular lens implantation in Fuchs heterochromic cyclitis. Ophthalmology 1995;102:1362–8.
10. Okhravi N, Lightman SL, Towler HMA. Assessment of visual outcome after cataract surgery in patients with uveitis. Ophthalmology 1999;106:710–22.
11. Kang YH, Lee JH. Phacoemulsification and posterior chamber intraocular lens implantation in uveitis. Korean J Ophthalmol 1997;11:94–7.
12. Lam DSC, Law RWK, Wong AKK. Phacoemulsification, primary posterior capsulorrhexis and capsular intraocular lens implantation for uveitis cataract. J Cataract Refract Surg 1998;24:1111–8.
13. Rauz S, Stavrou P, Murray PI. Evaluation of foldable intraocular lenses in patients with uveitis. Ophthalmology 2000;107:909–19.
14. Jones NP. Uveitis and cataract; advice for patients. In: Uveitis: an illustrated manual. Oxford: Butterworth-Heinemann, 1998:355–7 (appendix 2).
15. Kaufman AH, Foster CS. Cataract extraction in patients with pars planitis. Ophthalmology 1993;100:1210–7.
16. Akova YA, Foster CS. Cataract surgery in patients with sarcoidosis-associated uveitis. Ophthalmology 1994;101:473–9.
17. Moorthy RS, Rajeev B, Smith RE, Rao NA. Incidence and management of cataracts in Vogt-Koyanagi-Harada syndrome. Am J Ophthalmol 1994;118:197–204.
18. Jones NP. Cataract surgery in Fuchs' heterochromic uveitis: past, present and future. J Cataract Refract Surg 1996;22:261–8.
19. Sanders DR, Kraff MC, Liebermann HI, *et al*. Breakdown and re-establishment of blood–aqueous barrier with implant surgery. Arch Ophthalmol 1982;100:588–90.
20. Schauersberger J, Kruger A, Muller-Eidenbock A, *et al*. Long-term disorders of the blood–aqueous barrier after small-incision cataract surgery. Eye 2000;14:61–3.
21. Pande MV, Spalton DJ, Kerr-Muir MG, Marshall J. Postoperative inflammatory response to phacoemulsification and extracapsular cataract surgery: aqueous flare and cells. J Cataract Refract Surg 1996;22(Suppl):770–4.
22. Laurell C-G, Zetterstrom C, Philipson B, Syren-Nordqvist S. Randomised study of the blood–aqueous barrier reaction after phacoemulsification and extracapsular cataract extraction. Acta Ophthalmol Scand 1998;76:573–8.
23. Chee SP, Ti SE, Sivakumar M, Tan DT. Postoperative inflammation: extracapsular cataract extraction versus phacoemulsification. J Cataract Refract Surg 1999;25:1280–5.
24. Holland GN, van Horn SD, Margolis TP. Cataract surgery with ciliary sulcus fixation of intraocular lenses in patients with uveitis. Am J Ophthalmol 1999;128:21–30.
25. Jones NP. Fuchs' heterochromic uveitis: a reappraisal of the clinical spectrum. Eye 1991;5:649–61.
26. Mondino BJ, Nagata S, Glovsky MM. Activation of the alternative complement pathway by intraocular lenses. Invest Ophthalmol Vis Sci 1985;26:905–8.
27. Obstbaum SA. Biologic relationship between poly-methylmethacrylate intraocular lenses and uveal tissue. J Cataract Refract Surg 1992;18:219–31.
28. Percival SPB, Pai V. Heparin-modified lenses for eyes at risk for breakdown of the blood–aqueous barrier during cataract surgery. J Cataract Refract Surg 1993;19:760–5.
29. Jones NP. Cataract surgery using heparin surface-modified intraocular lenses in Fuchs' heterochromic uveitis. Ophthalmic Surg 1995;26:49–52.
30. Seward HC. Folding intraocular lenses: materials and methods. Br J Ophthalmol 1997;81:340–1.
31. Foster CS, Barrett F. Cataract development and cataract surgery in patients with juvenile rheumatoid arthritis-associated iridocyclitis. Ophthalmology 1993;100:809–17.
32. Probst LE, Holland EJ. Intraocular lens implantation in patients with juvenile rheumatoid arthritis. Am J Ophthalmol 1996;122:161–70.
33. Dana MR, Chatzistefanou K, Schaumberg DA, Foster CS. Posterior capsule opacification after cataract surgery in patients with uveitis. Ophthalmology 1997;104:1387–94.