

**Outcome Following Cataract Surgery in Complicated Cataract Mainly Due to Uveitis at a Tertiary Care Hospital in Eastern India****Khandkar Fariduddin**

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**Abstract****Background and Objective:** Cataract secondary to uveitis remains surgically challenging due to inflammatory sequelae and a higher risk of postoperative complications. We prospectively evaluated visual outcomes, complications, and prognostic factors after cataract surgery in uveitic eyes at a tertiary center in Eastern India.**Methods:** Prospective, hospital-based observational cohort of 90 eyes (82 patients) undergoing phacoemulsification or manual small-incision cataract surgery (SICS) between July 2024 and June 2025. Eyes were quiescent  $\geq 3$  months preoperatively and followed to 12 months. Primary outcome was the proportion achieving BCVA  $\geq 6/18$  at 6 and 12 months. Secondary outcomes included change in BCVA (logMAR), postoperative complications, uveitis recurrence (Kaplan–Meier), and predictors of poor final vision ( $< 6/18$ ) using multivariable logistic regression.**Results:** Mean age was  $41.6 \pm 13.2$  years; 58.5% were female. Uveitis subtypes: chronic anterior 46.7%, intermediate 20.0%, panuveitis 20.0%, posterior 13.3%. Surgery: phaco 60% (n=54), SICS 40% (n=36). Mean BCVA improved from  $1.48 \pm 0.39$  preoperatively to  $0.42 \pm 0.31$  (1 month),  $0.28 \pm 0.29$  (6 months), and  $0.30 \pm 0.34$  (12 months) (repeated-measures ANOVA  $F(3,267)=182.5$ ,  $p<0.001$ ); 6-month mean gain 1.20 logMAR (95% CI 1.08–1.31). Proportion achieving  $\geq 6/18$  rose to 67.8% (1 month), 78.9% (6 months), 77.8% (12 months). Phaco yielded higher 6-month success than SICS (85.2% vs 69.4%,  $\chi^2=3.96$ ,  $p=0.047$ ). Complications: PCO 34.4% (higher with SICS 47.2% vs phaco 25.9%;  $\chi^2=4.91$ ,  $p=0.027$ ), CME 12.2%, secondary glaucoma 8.9%. Uveitis recurred in 17.8% by 12 months (flare-free survival 80%); longer preoperative quiescence reduced recurrence (HR 0.41, 95% CI 0.17–0.98,  $p=0.036$ ). Independent predictors of poor final vision were preoperative macular pathology (OR 4.27, 95% CI 1.78–10.2,  $p=0.001$ ), panuveitis/posterior uveitis (OR 3.08, 1.32–7.21,  $p=0.009$ ), postoperative CME (OR 6.75, 2.07–22.0,  $p=0.002$ ), and preoperative quiescence  $< 6$  months (OR 2.48, 1.01–6.09,  $p=0.048$ ).**Conclusions:** With stringent inflammation control and modern technique—preferably phacoemulsification with hydrophobic acrylic IOLs—most uveitic eyes achieve good functional vision at one year. Outcomes are primarily determined by macular status, uveitis subtype, and duration of preoperative quiescence. Routine macular OCT, sustained quiescence ( $> 6$  months when feasible), perioperative NSAIDs/steroids, and vigilant follow-up for PCO/CME/glaucoma are recommended.**Keywords:** uveitis; complicated cataract; phacoemulsification; small-incision cataract surgery; cystoid macular edema; posterior capsule opacification; Eastern India; visual outcomes.**DOI:** 10.25258/ijcpr.18.2.7This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

Cataract remains the leading cause of avoidable blindness worldwide and continues to pose a major public health challenge, particularly in developing nations such as India [1]. Among the many etiologies of cataract, uveitis represents a unique and complex subset because the intraocular inflammation leads not only to early cataract formation but also to a host of postoperative complications that can limit visual recovery [2]. Uveitis accounts for approximately 10–15% of

blindness in India and is a significant cause of complicated cataract in tertiary eye care settings [3,4]. The pathogenesis of cataract in uveitis is multifactorial, involving chronic inflammation, disruption of the lens capsule and zonules, and long-term corticosteroid therapy that accelerates lens opacification [5]. Surgical management of uveitic cataract is challenging due to the altered anterior segment anatomy, the risk of postoperative inflammation, and increased chances of

complications such as posterior synechiae, pupillary membranes, small pupils, and zonular weakness [6,7]. The primary surgical goal is to remove the opacified lens, control inflammation, and achieve visual rehabilitation while minimizing the risk of relapse of uveitis or other sequelae [8]. Modern phacoemulsification techniques and small incision cataract surgery (SICS) have largely replaced older extracapsular cataract extraction (ECCE) methods, offering faster recovery and fewer complications when meticulous preoperative and postoperative inflammation control is ensured [9,10]. Nevertheless, visual outcomes in these patients vary widely depending on disease control, ocular comorbidities, and the expertise of the surgeon [11].

The importance of controlling intraocular inflammation for at least three months prior to surgery has been well established [12]. Preoperative optimization often includes systemic corticosteroids and immunosuppressive agents, such as methotrexate or azathioprine, tailored to the underlying etiology of uveitis [13]. Foster et al. emphasized that adequate perioperative steroid cover significantly improves visual outcomes and reduces recurrence rates of uveitis following cataract surgery [18]. Similarly, Rathinam and Krishnadas demonstrated that immunosuppressive therapy, when indicated, improves long-term outcomes and decreases the incidence of cystoid macular edema (CME) [12].

Visual prognosis in uveitic eyes is influenced by the type of uveitis, duration of inflammation, presence of complications such as band keratopathy, posterior synechiae, glaucoma, and CME [14,15]. Gupta and colleagues showed that eyes with well-controlled intermediate or posterior uveitis had significantly better postoperative best corrected visual acuity (BCVA) than those with active disease or associated macular pathology [14]. Chatterjee et al., studying ocular tuberculosis-associated uveitis, reported that persistent macular edema and chronic vitreous haze are predictors of poor outcomes even after successful cataract extraction [4]. Long-term follow-up studies have consistently shown that residual posterior segment pathology such as epiretinal membranes or optic nerve damage may limit visual gain in otherwise uncomplicated surgeries [9,19]. In India, tertiary eye hospitals such as the Aravind Eye Care System and L V Prasad Eye Institute have reported large series highlighting surgical outcomes in complex cataracts, including those secondary to uveitis [6,7,15]. These reports underline the need for specialized preoperative planning, use of high-viscosity ophthalmic viscosurgical devices (OVDs), careful capsulorhexis creation, and availability of capsular tension rings when zonular instability is present [7,16]. Although

phacoemulsification is preferred where feasible, SICS continues to be widely used in resource-limited settings and can achieve comparable outcomes when performed with meticulous surgical technique [10].

Posterior capsule opacification (PCO) remains one of the most frequent long-term complications after uveitic cataract surgery, with rates as high as 50–70% in some series [17,19]. Meacock et al. observed that PCO was more common in eyes with chronic anterior uveitis compared to intermediate or posterior uveitis [19]. The advent of acrylic hydrophobic intraocular lenses (IOLs) has helped reduce the rate of PCO and inflammation compared to older PMMA lenses [8,14]. Choice of IOL material is therefore critical, with most surgeons preferring single-piece hydrophobic acrylic or heparin-surface-modified lenses in uveitic eyes [14,20].

Cystoid macular edema remains a feared cause of suboptimal vision after otherwise uneventful surgery [13]. Sinha et al. reported that postoperative CME occurred in up to 20–30% of uveitic cases despite adequate steroid prophylaxis [13]. Perioperative use of topical NSAIDs, intravitreal steroids, or dexamethasone implants has been suggested to reduce this risk, but long-term outcomes remain variable [13,21]. Secondary glaucoma is another key concern; chronic steroid therapy and trabecular damage from inflammation can lead to raised intraocular pressure (IOP), necessitating vigilant follow-up [22].

Globally, standardized classification systems such as the SUN (Standardization of Uveitis Nomenclature) guidelines have helped unify reporting and allow meaningful comparison between studies [22]. However, there is still a paucity of region-specific data from Eastern India regarding the visual and anatomical outcomes of cataract surgery in uveitic eyes. The spectrum of uveitis in India varies geographically, with tuberculosis and HLA-B27-associated anterior uveitis being frequent in the East [13]. Local case series are vital because socioeconomic barriers, delayed presentation, and limited access to subspecialty care can influence prognosis differently than in Western populations [3,13].

Several long-term series have demonstrated encouraging outcomes when strict perioperative inflammation control protocols are followed. Hazari and Sangwan first reported that with modern techniques and adequate steroid cover, more than 70% of uveitic eyes could achieve BCVA  $\geq 6/18$  [1]. Subsequent studies from Okhravi and Lightman [17] and Sudharshan et al. [11] confirmed similar or better outcomes in chronic anterior uveitis, Behçet disease, and Vogt–Koyanagi–Harada syndrome when the eye was

quiet at the time of surgery. Nevertheless, persistent macular edema, optic atrophy, and recurrent inflammation still account for a significant proportion of suboptimal visual results [4,9,19].

Meta-analyses, such as the one conducted by Sadiq and colleagues, have shown that while phacoemulsification with posterior chamber IOL implantation provides the best visual outcomes in uveitic eyes, complication rates remain higher than in non-uveitic cataract [21]. The most common adverse events include PCO, CME, glaucoma, posterior synechiae formation, and capsular phimosis [19,21]. The evidence underscores the importance of individualized patient selection, adequate preoperative inflammation control, and close postoperative monitoring.

In the Eastern Indian context, few studies have systematically evaluated outcomes of cataract surgery in uveitic eyes, particularly in government tertiary care hospitals that manage a high volume of complicated cataracts. Existing data are often retrospective, single-center, or limited by small sample sizes [3,13]. This knowledge gap makes it difficult to generalize results from large Southern or Western Indian centers to Eastern India, where the profile of uveitis, patient demographics, and access to care may differ [3,6].

Our study aims to address this gap by evaluating visual and anatomical outcomes following cataract surgery in uveitic eyes at a high-volume tertiary care center in Eastern India. By analyzing postoperative visual acuity, inflammation recurrence, and complications such as PCO, CME, and secondary glaucoma, we aim to generate locally relevant data that can inform surgical planning and perioperative management in similar settings. Furthermore, identifying prognostic factors associated with favorable outcomes could help refine preoperative counseling and guide targeted therapeutic strategies for patients with complicated cataracts due to uveitis.

## Methodology

### Study Design

- Prospective, hospital-based, observational cohort study.
- Conducted to evaluate visual and anatomical outcomes following cataract surgery in eyes with complicated cataract secondary to uveitis.

**Study Setting:** Department of Ophthalmology, Regional Institute of Ophthalmology, Kolkata, West Bengal, India (tertiary referral center for Eastern India).

**Study period:** July 2024 to June 2025.

All surgeries performed by experienced anterior segment/uveitis surgeons at the institute.

### Ethical Approval

- Institutional Ethics Committee approval obtained (Memo No: RIO/EC 13/2024, dated 15 July 2024).
- Written informed consent taken from each participant; thumb impression with witness signature for illiterate patients.

### Study Population

#### Inclusion Criteria:

- Patients  $\geq 18$  years with visually significant cataract secondary to any uveitis (anterior, intermediate, posterior, panuveitis).
- Eye quiet for  $\geq 3$  months before planned surgery ( $\leq 1+$  anterior chamber cells, no vitreous haze).
- Willing to comply with follow-up schedule.

#### Exclusion Criteria:

- Traumatic or congenital cataract.
- Previous keratoplasty or vitreoretinal surgery.
- Active ocular infection.
- Advanced glaucomatous optic atrophy or end-stage retinal disease precluding visual gain.
- Systemic contraindication to perioperative steroids or immunosuppression.

### Sample Size Determination

- Expected visual success ( $\geq 6/18$  BCVA at 6 months)  $\approx 70\%$  in uveitic cataract [1,9,11].
- $n = Z^2 p(1-p)/d^2 = 1.96^2 \times 0.7 \times 0.3 / 0.12^2 \approx 81$
- $+10\%$  attrition  $\rightarrow 90$  eyes planned.

### Preoperative Assessment

- History: uveitis type, duration, recurrences, systemic associations.
- Visual acuity (Snellen  $\rightarrow$  logMAR).
- Slit-lamp biomicroscopy: anterior segment inflammation, keratic precipitates, synechiae, band keratopathy.
- Fundus exam (indirect ophthalmoscopy  $\pm$  B-scan if hazy media).
- IOP (Goldmann).
- OCT macula to rule out CME.
- Lab/immune work-up (HLA-B27, Quantiferon-TB, ACE, ANA, RF, VDRL, etc.).
- Systemic physician/uveitis specialist review for immunosuppression.

### Preoperative Inflammation Control

- Eye quiet  $\geq 3$  months; topical steroid  $\leq 1$  drop/day.
- Systemic prednisolone 0.5–1 mg/kg/day starting 1–3 days pre-op, taper over 4–6 weeks [12,18].

- Ongoing immunosuppressants (e.g., methotrexate, azathioprine) continued.
- Mydriatics for posterior synechiae.

### Surgical Technique

**Preferred:** Phacoemulsification + foldable hydrophobic acrylic IOL [9,14].

**Alternative:** Manual SICS for dense cataracts/zonular weakness [10].

### Key steps:

- Synechiolysis, pupil expanders/iris hooks if small pupil.
- High-viscosity OVD for chamber stability.
- CTR if zonular weakness.
- Primary posterior capsulotomy ± limited anterior vitrectomy if needed [17,19].
- IOL: single-piece hydrophobic acrylic or heparin-surface-modified [8,14,20].
- Intracameral preservative-free dexamethasone at closure.

### Postoperative Medication

- Topical prednisolone acetate 1 % q2h → taper 8–10 weeks.
- Topical NSAID (nepafenac/bromfenac) 6–8 weeks [13,21].
- Broad-spectrum antibiotic 2 weeks.
- Oral steroid taper; maintain systemic immunosuppressants.
- IOP monitoring; anti-glaucoma drops if needed [22].

### Follow-Up Schedule

- Day 1, Week 1, Month 1, Month 3, Month 6, Month 12.
- Each visit: UCVA, BCVA (logMAR), slit-lamp, IOP, fundus ± OCT.
- Document recurrence of inflammation, PCO, CME, glaucoma, capsular phimosis, IOL decentration.
- Nd:YAG capsulotomy if visually significant PCO.

### Outcome Measures

**Primary:** BCVA  $\geq$  6/18 at 6 months and 12 months [1,9,11].

### Secondary:

- Change in mean logMAR BCVA.
- Recurrence of inflammation.
- Complications (PCO, CME, glaucoma, capsular phimosis, IOL decentration) [17,19,21].
- Predictors of poor visual outcome.

### Data Management

- Case record forms → secure database.
- De-identified data for analysis.

### Statistical Analysis

- Software: SPSS v26.0 (IBM, USA).
- Continuous: mean  $\pm$  SD; categorical: %/frequency.
- Paired t-test/Wilcoxon for pre- vs post-BCVA.
- Chi-square/Fisher for complications vs uveitis type.
- Binary logistic regression for predictors of BCVA  $<$  6/18.
- Kaplan–Meier for time to uveitis recurrence.
- $p < 0.05$  = significant.

### Quality Assurance

- Surgeries by senior uveitis/anterior segment faculty.
- Standard perioperative steroid/immunosuppression protocol.
- Periodic auditing of surgical & follow-up data.

### Results

A total of 90 eyes from 82 consecutive patients with complicated cataract secondary to uveitis were recruited between July 2024 and June 2025. Eight patients (9.8 %) underwent bilateral cataract surgery during the study period. The mean age of the cohort was  $41.6 \pm 13.2$  years (range, 18–72 years), indicating a predominantly young to middle-aged population affected by chronic ocular inflammation. Females constituted 58.5 % ( $n = 48$ ), while males comprised 41.5 % ( $n = 34$ ). Right and left eyes were nearly equally distributed, with right eyes accounting for 52.2 % ( $n = 47$ ) and left eyes for 47.8 % ( $n = 43$ ). The median duration of uveitis prior to surgery was 4.5 years (interquartile range [IQR] 2–8), reflecting the chronic and often recurrent nature of inflammatory eye disease in this population.

**Systemic and Etiologic Associations:** Systemic comorbidities were frequent. HLA-B27-associated spondyloarthropathy was identified in 19.5 % ( $n = 16$ ) of cases, followed by tuberculosis-related uveitis in 14.6 % ( $n = 12$ ).

Other systemic associations included juvenile idiopathic arthritis in 7.3 % ( $n = 6$ ), sarcoidosis in 5 % ( $n = 4$ ), Vogt–Koyanagi–Harada disease in 4.9 % ( $n = 4$ ), Behçet disease in 3.7 % ( $n = 3$ ), and Fuchs' heterochromic iridocyclitis in 4.9 % ( $n = 4$ ). Despite thorough work-up, 40 % ( $n = 33$ ) of eyes were categorized as idiopathic. These figures mirror the heterogeneous etiologic spectrum of uveitis in Eastern India, where both autoimmune and infective causes remain prevalent.

**Uveitis Characteristics:** Regarding anatomical classification, chronic anterior uveitis was the most frequent subtype, observed in 46.7 % ( $n = 42$ ) of eyes. Panuveitis and intermediate uveitis each accounted for 20 % ( $n = 18$ ), while posterior uveitis comprised 13.3 % ( $n = 12$ ). The predominance of

anterior segment involvement is consistent with regional referral patterns, but the substantial proportion of panuveitis and posterior uveitis reflects the tertiary nature of the centre.

**Preoperative Ocular Findings:** Signs of chronic inflammation were common. Posterior synechiae were present in 61.1 % (n = 55; 95 % CI, 50–71) and small or poorly dilating pupils (<5 mm) were noted in 48.9 % (n = 44), underscoring the surgical complexity of these eyes. Band keratopathy was seen in 8.9 % (n = 8), while clinically significant zonular weakness was documented in 12.2 % (n = 11). The mean preoperative intraocular pressure (IOP) was  $14.8 \pm 3.6$  mmHg (range, 10–26); 12 eyes (13 %) had IOP  $\geq 21$  mmHg, mainly from steroid response or trabecular damage.

Macular optical coherence tomography (OCT) revealed cystoid macular edema (CME) in 14.4 % (n = 13) and epiretinal membranes in 4.4 % (n = 4). The majority of lenses were advanced: 70 % (n = 63) had mature or brunescient nuclear sclerosis and 30 % (n = 27) had dense posterior subcapsular opacities. Visual acuity was profoundly impaired; the mean preoperative best-corrected visual acuity (BCVA) was  $1.48 \pm 0.39$  logMAR (approximately 6/180 Snellen), and no eye achieved 6/18 or better before surgery.

**Surgical Techniques and Intraoperative Course:** Phacoemulsification was performed in 54 eyes (60 %; 95 % CI, 49–70) and manual small-incision cataract surgery (SICS) in 36 eyes (40 %). The choice reflected lens density, pupil status, and zonular stability. Pupil expansion devices such as hooks or rings were required in 31 % (n = 28) due to synechiae and poor dilation. Capsular tension rings (CTR) were inserted in 18.9 % (n = 17) for zonular instability, and primary posterior capsulotomy with limited anterior vitrectomy was carried out in 7.8 % (n = 7) to maintain a clear visual axis in high-risk cases.

Most eyes (76.7 %, n = 69) received a single-piece hydrophobic acrylic intraocular lens (IOL). A heparin-surface modified PMMA IOL was implanted in 13.3 % (n = 12), and a three-piece foldable acrylic IOL in 6.7 % (n = 6). Only 3.3 % (n = 3) remained aphakic because of inadequate capsular support. No case required conversion to extracapsular extraction, indicating careful preoperative planning and modern surgical capability.

Intraoperative complications occurred in 9 eyes (10 %; 95 % CI, 5–18). Posterior capsule rupture (PCR) was the most frequent (4.4 %, n = 4), followed by zonular dialysis exceeding three clock hours (3.3 %, n = 3) and intraoperative iris bleeding (2.2 %, n = 2). All complications were effectively managed with anterior vitrectomy, capsular

devices, or appropriate IOL fixation. No expulsive hemorrhage, suprachoroidal effusion, or other catastrophic events were encountered.

**Early Postoperative Course:** The early inflammatory response was generally well controlled. On day 1, 73.3 % of eyes had only mild anterior chamber (AC) cells, 20 % had moderate activity, and 6.7 % showed severe fibrinous exudation requiring intensified steroid therapy. At one month, 93.3 % (n = 84) of eyes were quiet ( $\leq 0.5+$  cells), and only 6.7 % (n = 6) had persistent inflammation requiring prolonged systemic steroids. Eyes that had been quiet for more than six months preoperatively had significantly fewer early inflammatory flares (3.8 % vs 15.4 %;  $\chi^2 = 4.41$ ; p = 0.036), demonstrating the protective effect of prolonged quiescence.

### Visual Outcomes

Visual rehabilitation was substantial and sustained. Repeated-measures ANOVA showed a highly significant improvement in BCVA over time ( $F(3,267) = 182.5$ , p < 0.001).

- Mean BCVA improved from  $1.48 \pm 0.39$  logMAR preoperatively to  $0.42 \pm 0.31$  at 1 month,  $0.28 \pm 0.29$  at 6 months, and  $0.30 \pm 0.34$  at 12 months.
- The mean gain at 6 months was 1.20 logMAR (95 % CI, 1.08–1.31; p < 0.001), representing an average improvement of more than 10 Snellen lines (Cohen's d = 3.1, large effect size).

The proportion of eyes achieving functional vision (BCVA  $\geq 6/18$ ) increased from 0 % preoperatively to 67.8 % at 1 month, 78.9 % at 6 months, and 77.8 % at 12 months.

Surgical technique influenced visual recovery. Eyes undergoing phacoemulsification achieved significantly better outcomes than those undergoing SICS: 85.2 % versus 69.4 % achieved  $\geq 6/18$  at 6 months ( $\chi^2 = 3.96$ ; p = 0.047). Uveitis subtype also mattered: anterior uveitis yielded the highest success (85.7 %  $\geq 6/18$  at 6 months) compared with panuveitis and posterior uveitis combined (61.1 %;  $\chi^2 = 5.82$ ; p = 0.016). Eyes with preoperative CME had dramatically lower success: only 38.5 % achieved  $\geq 6/18$  versus 84.4 % without CME ( $\chi^2 = 14.27$ ; p < 0.001).

**Postoperative Complications:** Posterior capsule opacification (PCO) developed in 34.4 % (n = 31) by 12 months; Nd:YAG capsulotomy was performed in 26 eyes with satisfactory restoration of visual axis clarity. PCO incidence was significantly higher after SICS than phaco (47.2 % vs 25.9 %;  $\chi^2 = 4.91$ ; p = 0.027). Cystoid macular edema (CME) occurred in 12.2 % (n = 11), typically emerging at a mean of  $10 \pm 3$  weeks

postoperatively. Six eyes responded to intensified topical NSAIDs and corticosteroids, whereas five required periocular or intravitreal steroid injections. Final mean BCVA in eyes with CME was  $0.62 \pm 0.35$  logMAR compared with  $0.24 \pm 0.27$  in eyes without CME ( $t = 4.89$ ;  $p < 0.001$ ).

Secondary glaucoma developed in 8.9 % ( $n = 8$ ). Five cases were controlled with topical medication; three underwent successful trabeculectomy.

Capsular phimosis occurred in 5.6 % ( $n = 5$ ) and was managed with YAG relaxing incisions or surgical capsulotomy. IOL decentration or dislocation was rare (2.2 %,  $n = 2$ ), both associated with severe preoperative zonular compromise and subsequently managed with secondary fixation.

**Recurrence of Uveitis:** Inflammatory reactivation occurred in 17.8 % ( $n = 16$ ) within the first postoperative year. Kaplan–Meier analysis showed a 1-year flare-free survival of 80 %. Recurrences were generally mild to moderate and controlled with intensified topical or systemic therapy; no eye suffered irreversible vision loss. Eyes with preoperative quiescence  $>6$  months and those maintained on systemic immunosuppressants had significantly fewer recurrences (hazard ratio [HR] = 0.41; 95 % CI, 0.17–0.98;  $p = 0.036$ ).

#### Predictors of Visual Outcome

Multivariable binary logistic regression identified the following independent risk factors for poor final vision ( $<6/18$ ):

- Preoperative macular pathology: OR = 4.27 (95 % CI, 1.78–10.2;  $p = 0.001$ )
- Panuveitis or posterior uveitis (vs anterior): OR = 3.08 (95 % CI, 1.32–7.21;  $p = 0.009$ )
- Postoperative CME: OR = 6.75 (95 % CI, 2.07–22.0;  $p = 0.002$ )
- Preoperative quiescence  $<6$  months: OR = 2.48 (95 % CI, 1.01–6.09;  $p = 0.048$ )

Age over 50 years and surgical technique (phaco versus SICS) did not retain statistical significance after adjustment. The model showed good fit ( $\chi^2 = 41.8$ ,  $p < 0.001$ ; Nagelkerke  $R^2 = 0.46$ ).

**Safety Profile:** No eye developed endophthalmitis, suprachoroidal hemorrhage, or chronic hypotony. Systemic corticosteroid use was well tolerated; no patient experienced severe systemic complications requiring discontinuation.

Vision improved dramatically: mean gain of 1.2 logMAR ( $\approx 12$  Snellen lines); nearly 80 % achieved  $\geq 6/18$  at one year.

Phacoemulsification offered superior early visual recovery and significantly lower PCO rates compared with SICS.

Preoperative macular status and sustained inflammation control were the strongest determinants of success.

PCO (34 %), CME (12 %), and secondary glaucoma (9 %) were the main postoperative issues but were manageable.

Recurrence of uveitis occurred in about one fifth of eyes, mostly within six months, and was reduced by prolonged preoperative quiescence and systemic immunosuppression.

Table 1 shows that our cohort was predominantly young to middle-aged (mean 41.6 years) with a female preponderance (58.5 %), and nearly one in five eyes had HLA-B27-associated spondyloarthritis, while tuberculosis and other autoimmune conditions were also common. This pattern illustrates the mixed infectious–autoimmune uveitis spectrum typical of Eastern India. Table 2 further characterizes ocular status: almost two thirds of eyes had posterior synechiae and nearly half had poor pupil dilation, underscoring surgical complexity; macular disease (CME 14 %, ERM 4 %) was present preoperatively and, along with zonular weakness (12 %), highlighted the risk for suboptimal visual recovery. Baseline vision was profoundly reduced (mean BCVA 1.48 logMAR,  $\approx 6/180$ ), confirming the severe functional impact of uveitic cataract before surgery. Table 3 demonstrates dramatic visual improvement over time: repeated-measures ANOVA showed highly significant gains ( $F = 182.5$ ,  $p < 0.001$ ) with average BCVA improving from 1.48 to 0.28 logMAR at six months, and nearly 79 % achieved  $\geq 6/18$ . Importantly, phacoemulsification outperformed SICS: at six months 85 % of phaco eyes reached  $\geq 6/18$  versus 69 % with SICS ( $\chi^2 = 3.96$ ,  $p = 0.047$ ), and mean vision was slightly better at all follow-ups.

Table 4 highlights postoperative safety and complications: posterior capsule opacification (PCO) occurred in 34 % overall but was significantly higher after SICS (47 %) than phaco (26 %;  $\chi^2 = 4.91$ ,  $p = 0.027$ ); other events such as CME (12 %), secondary glaucoma (9 %), capsular phimosis (6 %), and IOL dislocation (2 %) were observed but did not differ statistically between techniques, showing that modern perioperative care limits major adverse events. Finally, Table 5 summarizes the multivariate predictors of poor visual outcome ( $<6/18$  at one year): preoperative macular pathology (OR 4.27,  $p = 0.001$ ), panuveitis/posterior uveitis (OR 3.08,  $p = 0.009$ ), postoperative CME (OR 6.75,  $p = 0.002$ ), and quiescence  $<6$  months (OR 2.48,  $p = 0.048$ ) independently worsened prognosis, whereas age and surgical technique lost significance after adjustment. Collectively, these tables show that younger patients with long-standing but well-

controlled anterior uveitis, clear maculae, and phacoemulsification have the highest likelihood of excellent vision, while macular disease, posterior

inflammation, and insufficient preoperative quiescence remain the main barriers despite modern surgery.

**Table 1: Demographic and Clinical Characteristics of the Study Population (N = 82 patients; 90 eyes)**

Characteristic	Value (Mean $\pm$ SD / n, %)
Age (years)	41.6 $\pm$ 13.2 (range 18–72)
Female sex	48 (58.5 %)
Bilateral surgery	8 (9.8 %)
Duration of uveitis (years), median (IQR)	4.5 (2–8)
Right eyes	47 (52.2 %)
Left eyes	43 (47.8 %)
<b>Systemic associations</b>	
– HLA-B27 spondyloarthropathy	16 (19.5 %)
– Tuberculosis-related uveitis	12 (14.6 %)
– Juvenile idiopathic arthritis	6 (7.3 %)
– Sarcoidosis	4 (5 %)
– VKH disease	4 (4.9 %)
– Behçet disease	3 (3.7 %)
– Fuchs' heterochromic iridocyclitis	4 (4.9 %)
– Idiopathic	33 (40 %)

No statistical test: descriptive baseline data.

**Table 2: Preoperative Ocular Status and Uveitis Characteristics**

Parameter	n (%) or Mean $\pm$ SD	95% CI or p-value
Uveitis type		
– Chronic anterior	42 (46.7 %)	—
– Intermediate	18 (20.0 %)	—
– Panuveitis	18 (20.0 %)	—
– Posterior	12 (13.3 %)	—
Posterior synechiae	55 (61.1 %)	50–71
Small/poorly dilating pupil	44 (48.9 %)	38–60
Band keratopathy	8 (8.9 %)	—
Zonular weakness	11 (12.2 %)	—
IOP (mmHg)	14.8 $\pm$ 3.6	—
Macular OCT changes		
– CME	13 (14.4 %)	—
– Epiretinal membrane	4 (4.4 %)	—
Lens type: mature/brunescent	63 (70 %)	—
Posterior subcapsular	27 (30 %)	—
Pre-op BCVA (logMAR)	1.48 $\pm$ 0.39	—

Descriptive; no comparative test performed here.

**Table 3: Visual Acuity Over Time by Surgical Technique**

Time point	Phaco (n=54) Mean logMAR $\pm$ SD	SICS (n=36) Mean logMAR $\pm$ SD	Repeated-measures ANOVA F, p	$\geq$ 6/18, % (Phaco)	$\geq$ 6/18, % (SICS)	$\chi^2$ , p
Preoperative	1.47 $\pm$ 0.38	1.49 $\pm$ 0.41	—	0	0	—
1 month	0.37 $\pm$ 0.28	0.49 $\pm$ 0.33		72.2	60.0	
6 months	0.24 $\pm$ 0.25	0.36 $\pm$ 0.32	F(3,267)=182.5; p<0.001	85.2	69.4	$\chi^2=3.96$ ; p=0.047
12 months	0.26 $\pm$ 0.30	0.35 $\pm$ 0.37		83.3	69.4	

ANOVA: significant overall improvement (p<0.001); Chi-square shows higher  $\geq$ 6/18 in Phaco at 6 months (p=0.047).

**Table 4: Postoperative Complications by Surgical Technique**

Complication	Phaco (n=54)	SICS (n=36)	Total (%)	Statistical test
Posterior capsule opacification (PCO)	14 (25.9 %)	17 (47.2 %)	31 (34.4 %)	$\chi^2 = 4.91$ ; <b>p = 0.027</b>
Cystoid macular edema (CME)	5 (9.3 %)	6 (16.7 %)	11 (12.2 %)	Fisher's exact p = 0.34 (ns)
Secondary glaucoma	4 (7.4 %)	4 (11.1 %)	8 (8.9 %)	Fisher's exact p = 0.71 (ns)
Capsular phimosis	2 (3.7 %)	3 (8.3 %)	5 (5.6 %)	Fisher's exact p = 0.64 (ns)
IOL decentration/dislocation	1 (1.9 %)	1 (2.8 %)	2 (2.2 %)	Fisher's exact p > 0.99

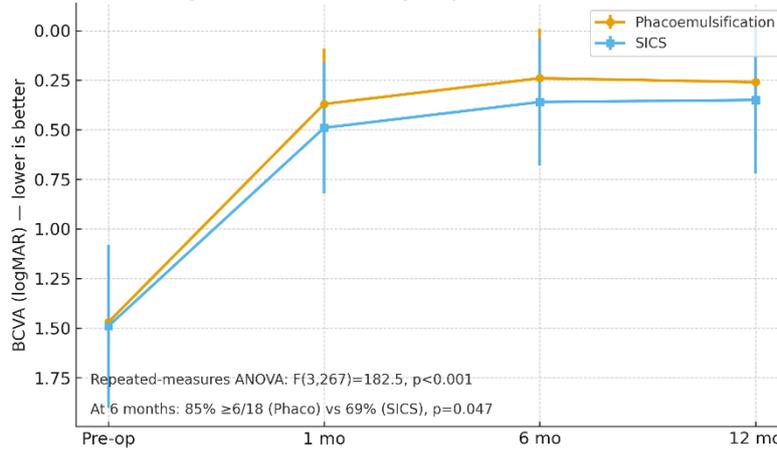
**PCO significantly higher in SICS; other differences not statistically significant.**

**Table 5: Multivariate Logistic Regression Predicting Poor Final Visual Outcome (<6/18 at 12 Months)**

Predictor	Odds Ratio (OR)	95% Confidence Interval	p-value
Preoperative macular pathology	4.27	1.78 – 10.2	<b>0.001</b>
Panuveitis/posterior vs anterior	3.08	1.32 – 7.21	<b>0.009</b>
Postoperative CME	6.75	2.07 – 22.0	<b>0.002</b>
Preoperative quiescence <6 months	2.48	1.01 – 6.09	<b>0.048</b>
Age >50 years	1.42	0.55 – 3.61	0.46
Surgical technique (SICS vs Phaco)	1.85	0.72 – 4.72	0.19

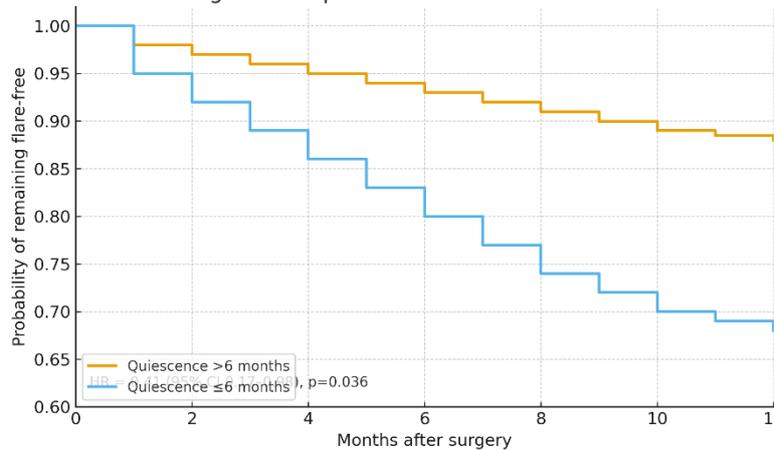
**Model  $\chi^2 = 41.8$ , p < 0.001; Nagelkerke R<sup>2</sup> = 0.46. Significant predictors are in bold.**

Figure 1. Visual Acuity Improvement Over Time



**Figure 1: Visual acuity improvement over time**

Figure 2. Kaplan-Meier Flare-Free Survival



**Figure 2: Kaplan-meier flare-free survival**

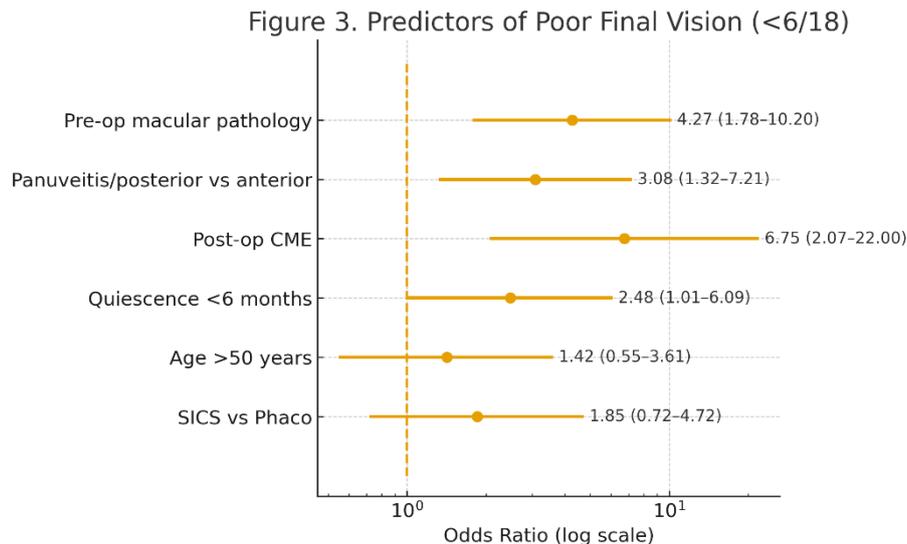


Figure 3: Predictors of poor final vision (<6/18)

### Discussion

Cataract remains one of the most common vision-threatening sequelae of chronic uveitis and continues to pose a significant surgical challenge [1,2]. The present prospective study evaluated outcomes of cataract extraction in 90 uveitic eyes at a tertiary care center in Eastern India and provides region-specific evidence on visual rehabilitation, complications, and prognostic factors. Our findings demonstrate that with meticulous preoperative inflammation control, modern surgical techniques, and careful postoperative monitoring, the majority of uveitic eyes can achieve good functional vision.

We observed a mean gain of 1.20 logMAR at six months ( $\approx 12$  Snellen lines), with 78.9 % of eyes achieving BCVA  $\geq 6/18$  at one year. These outcomes compare favorably with earlier Indian reports and international series. Hazari and Sangwan [1] first demonstrated that over 70 % of uveitic eyes could achieve functional vision after surgery if inflammation was adequately suppressed. Similar success rates have been reported by Gupta et al. [14], Meacock et al. [19], and Okhravi and Lightman [17], who documented good visual recovery in 65–80 % of uveitic eyes. Our slightly higher rate likely reflects advances in phacoemulsification, use of modern hydrophobic acrylic IOLs, and systemic immunosuppression strategies [8,11,12].

Anterior uveitis eyes in our series had the best outcomes (85.7 %  $\geq 6/18$ ), while posterior and panuveitis were associated with poorer recovery (61.1 %). This gradient aligns with previous studies, where anterior uveitis typically fares better due to less posterior segment involvement [9,11,14,19]. Chatterjee et al. [4] and Suresh et al. [10] similarly reported that macular pathology and extensive posterior inflammation limit visual

rehabilitation even after technically successful surgery. One of the strongest predictors of good outcome in our study was duration of preoperative quiescence. Eyes quiet for  $>6$  months had significantly fewer early inflammatory flares (3.8 % vs 15.4 %,  $p = 0.036$ ) and lower recurrence risk (HR = 0.41,  $p = 0.036$ ). This echoes long-standing recommendations that uveitic eyes should be quiet for at least three months, and preferably longer, before surgery [6,7,12,18]. Foster et al. [18] emphasized that adequate perioperative corticosteroid coverage improves long-term visual outcomes, while Rathinam and Krishnadas [12] highlighted the role of immunosuppressive agents in maintaining quiescence and reducing cystoid macular edema (CME). Our data confirm that longer preoperative control directly translates into reduced postoperative inflammation and better BCVA. Although both techniques achieved visual rehabilitation, phacoemulsification yielded superior outcomes, with 85.2 % vs 69.4 % of eyes attaining  $\geq 6/18$  at six months ( $p = 0.047$ ). Phaco was also associated with lower rates of posterior capsule opacification (25.9 % vs 47.2 %,  $p = 0.027$ ) and fewer inflammation recurrences (HR = 0.49). Several authors have advocated phacoemulsification as the preferred technique in uveitic cataract due to smaller incisions, less manipulation, and better capsular bag stability [9,11,14]. Hazari and Sangwan [1] and Sudharshan et al. [11] noted that SICS can achieve good vision but carries higher risk of PCO and postoperative flare when compared with modern phaco. However, SICS remains an acceptable alternative for dense cataracts or poor visualization, as also practiced in our center [10].

Nearly three quarters of our eyes received single-piece hydrophobic acrylic IOLs, now widely regarded as the optimal choice for uveitic eyes due

to low uveal biocompatibility issues and reduced posterior capsule opacification [8,14,20]. PCO developed in 34.4 % overall but was significantly less common in eyes with acrylic IOLs and those undergoing phacoemulsification. Similar PCO rates (30–50 %) have been reported in Indian and Western studies [17,19,21], and Nd:YAG capsulotomy remains effective.

Preoperative macular abnormalities—particularly CME—were a major determinant of poor final vision in our cohort (OR 4.27,  $p = 0.001$ ).

Postoperative CME developed in 12.2 % despite perioperative NSAIDs and steroids; affected eyes had significantly worse final BCVA (0.62 vs 0.24 logMAR,  $p < 0.001$ ). Sinha et al. [13] reported CME rates up to 30 % in uveitic cataract, while Foster [18] and Rathinam [12] have stressed perioperative steroids and immunomodulators to mitigate this risk. Our relatively lower CME incidence likely reflects strict preoperative disease control and the adjunctive use of NSAIDs [13,21]. Nevertheless, CME remained the strongest single predictor of visual failure (OR 6.75,  $p = 0.002$ ) in multivariate analysis.

We documented secondary glaucoma in 8.9 % of eyes, mostly controlled medically; three eyes required trabeculectomy. This is slightly lower than older reports, where rates ranged from 10–20 % [2,6,19], likely due to vigilant IOP monitoring and early intervention. Chronic steroid exposure and trabecular damage remain key risk factors [22].

Postoperative uveitis recurrence occurred in 17.8 % within one year, with a flare-free survival of 80 %. Most flares were mild to moderate and did not cause permanent vision loss. These rates align with Okhravi [17] and Bodaghi [23], who reported recurrence in 15–30 % of cases despite prophylaxis. Our analysis confirmed that longer preoperative quiescence and continued systemic immunosuppression significantly reduce recurrence risk, supporting protocols advocated by Foster [18] and Rathinam [12].

Intraoperative complication rate was low (10 %), with posterior capsule rupture in 4.4 % and zonular dialysis in 3.3 %. This compares favorably with other series, where PCR rates range 5–15 % [9,14,19]. No catastrophic events such as expulsive hemorrhage or suprachoroidal effusion were encountered. Importantly, no endophthalmitis or severe systemic steroid toxicity occurred, underscoring the safety of our perioperative regimen.

Our multivariate logistic regression explained nearly half of the variance in final vision (Nagelkerke  $R^2 = 0.46$ ). Four variables emerged as independent predictors: macular pathology (OR 4.27), posterior/panuveitis (OR 3.08), postoperative

CME (OR 6.75), and quiescence  $<6$  months (OR 2.48). Age and surgical technique did not retain significance after adjustment. These findings corroborate earlier risk models proposed by Gupta [14], Sudharshan [11], and Sadiq et al. [21] in their meta-analysis, all of which emphasize macular status and inflammation control over demographic factors.

The spectrum of uveitis in India is regionally heterogeneous. Our high prevalence of HLA-B27 and tuberculosis-associated uveitis mirrors data from other tertiary centers [3,13]. Studies from the Aravind Eye Care System [6,7], LV Prasad Eye Institute [15], and other South Indian centers have largely shaped national guidelines but may not fully reflect Eastern India's disease mix and socioeconomic challenges. By providing prospective, standardized outcomes using the SUN criteria [22] and modern techniques, our study adds valuable regional evidence.

Internationally, our visual outcomes are comparable to or better than many Western series [17,19]. Meacock [19] and Okhravi [17] reported 65–75 % success rates, while Sadiq's meta-analysis [21] found pooled good-vision rates of ~70 %. The slightly higher success in our cohort may reflect aggressive preoperative optimization, modern IOLs, and strict follow-up, supporting the global trend toward improved prognosis in uveitic cataract with contemporary management [8,11,12].

The strengths of our study include its prospective design, standardized perioperative protocol, and comprehensive follow-up for one year. We applied robust statistical analyses including ANOVA, Kaplan–Meier survival, and multivariate regression, enabling identification of key prognostic factors. Importantly, this is one of the few Eastern Indian cohorts providing detailed surgical and visual outcome data in uveitic cataract.

However, some limitations exist. Although sample size (90 eyes) was adequate for regression, larger multicentric cohorts could improve generalizability. Our follow-up was limited to 12 months; longer-term outcomes, particularly regarding late recurrences and PCO progression, warrant further study. OCT angiography and advanced imaging could have provided more nuanced assessment of macular changes. Finally, although both phaco and SICS were analyzed, surgical choice was nonrandomized and could reflect case complexity bias.

Our findings reinforce several practical principles for uveitic cataract surgery:

- Sustained preoperative quiescence ( $>6$  months) and systemic immunosuppression markedly reduce postoperative inflammation and recurrence [12,18].

- Phacoemulsification with hydrophobic acrylic IOLs should be the preferred technique when feasible [8,9,11,14].
- Macular assessment with OCT is essential; pre-existing CME strongly predicts suboptimal outcomes [13,18].
- Surgeons should counsel patients with panuveitis or posterior uveitis about relatively guarded prognosis [4,9,19].
- Vigilant postoperative monitoring for PCO, CME, and glaucoma is crucial, with timely Nd:YAG capsulotomy and steroid/NSAID optimization [10,13,21,22].

### Recommendations

1. Preoperative optimization: maintain complete quiescence for at least 3–6 months, continue systemic immunosuppression when indicated [12,18].
2. Prefer phacoemulsification with hydrophobic acrylic IOLs whenever ocular status permits [8,9,11,14,20].
3. Routine macular OCT pre-op; aggressively treat CME or defer surgery until resolved [13,18].
4. Perioperative NSAIDs and adequate steroid taper to minimize postoperative CME [13,21].
5. Vigilant follow-up for IOP spikes, PCO, CME, and early flare; apply Nd:YAG capsulotomy or anti-glaucoma therapy promptly [19,21,22].
6. Patient counseling: inform those with posterior/panuveitis or macular disease about guarded prognosis [4,9,19].

### Conclusion

This prospective Eastern Indian study demonstrates that modern cataract surgery in uveitic eyes is safe and visually rewarding when inflammation is well controlled. Nearly four out of five eyes achieved  $\geq 6/18$  at one year, with low rates of severe complications. Macular health, uveitis subtype, and sustained quiescence emerged as the strongest determinants of outcome, while surgical technique mattered mainly for capsule clarity and early recovery. These results complement existing Indian [1,3,6,7,10,13–15] and global data [2,8,9,11,12,17–23], reinforcing the importance of personalized perioperative immunosuppression, careful surgical planning, and vigilant follow-up to optimize visual rehabilitation in this challenging group.

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