ORIGINAL ARTICLE

Outcomes of Cataract Surgery and IOL Implantation in Anterior Uveitis

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Abstract

Background: Cataract formation is one of the most common complications of anterior uveitis. Cataract extraction in these patients poses a heightened risk of intraoperative and postoperative complications. Despite the advances in surgical methods and perioperative management strategies, recurrence of inflammation and poor clinical outcomes persist.

Objective: To evaluate preoperative conditions, postoperative visual and clinical results, and complications of cataract surgery in patients with anterior uveitis in Pakistan.

Methods: A prospective observational cohort study was conducted at LRBT Tertiary Teaching Eye Hospital from June 2023 to May 2024, including 65 patients with cataracts secondary to anterior uveitis. Patients were classified into four groups: (i) Idiopathic, (ii) Fuchs' heterochromic iridocyclitis, (iii) Infective anterior uveitis and (iv) non-infectious anterior uveitis. Preoperative evaluation included visual acuity assessment, slit-lamp examination, intraocular pressure measurement, and OCT when indicated. All patients underwent phacoemulsification with intraocular lens implantation. Postoperative outcomes, including best-corrected visual acuity (BCVA). Anterior chamber cells, flare and other complications were assessed at 1 week, 1 month, and 6 months. Data were analysed using SPSS version 25.

Results: Fuchs uveitis showed the most favourable and most sustained BCVA improvement. Non-infectious and idiopathic cases showed moderate gains, while infective anterior uveitis had the poorest outcomes. Complications included posterior capsular opacification (40%), cystoid macular edema (27.7%), and recurrent uveitis (12.3%). Intraocular pressure fluctuated but significantly decreased at six months ($p<0.001$).

Conclusion: Perioperative inflammation control is critical for favourable visual outcomes in uveitic cataract surgery. Optimised surgical strategies and meticulous postoperative care are crucial for improving outcomes and reducing complications in patients with anterior uveitis.

Keywords: *Cataract surgery, uveitis, visual outcomes, inflammation control, and intraocular lens implantation.*

INTRODUCTION

Uveitis is classified based on anatomical localisation into anterior, intermediate, posterior types and panuveitis [1]. It is a prevalent ocular inflammatory disorder that affects both the anterior and posterior segments of the eye, leading to structural and functional damage and resulting in various complications [2-4]. One of the most common complications of uveitis is cataract formation, which occurs in approximately 50-78% of uveitic eyes, with an annual incidence of 5-6%. The development of cataracts in uveitic patients is influenced by multiple factors, including the type of uveitis, severity and duration of inflammation, and the effectiveness of therapeutic intervention [2].

Cataract surgery in patients with uveitis presents significant surgical challenges due to factors such as pupillary constriction, posterior synechiae, pupillary membrane formation, and an increased risk of intraoperative bleeding secondary to iris neovascularisation. Additionally, corneal pathologies may further complicate the procedure, leading to an elevated risk of both intraoperative and postoperative complications [1, 2]. Intraocular inflammation is the most significant and feared serious complication of removing a uveitic cataract [3]. This inflammation can be significant, resulting in hypopyon development, protein exudation with the formation of fibrin membranes and a significant number of inflammatory cells (≥2+) in the anterior chamber [4, 5]. Significant visual loss due to cystoid macular edema and vitreous opacification are also other major complications [6]. Therefore, from a surgical perspective, it is vital to control post-operative inflammation to prevent serious complications [7]. Previously, primary intraocular lens (IOL) implantation was considered a risk factor for flare-ups of the inflammation and, therefore, contraindicated in patients with uveitis. In recent years, several studies have shown good results with primary IOL implantation in adult patients with uveitis, and in most cases, IOL implantation is no longer discouraged [7]. However, questions remain regarding optimal IOL material in the setting of uveitis [8, 9]. There is no consensus on the optimal surgical procedures and perioperative therapeutic regimens for different etiologies of uveitis [10].

Prior studies have assessed the outcomes of cataract surgery in uveitis, generally showing good postoperative visual function. This study aimed to evaluate preoperative conditions and postoperative outcomes after cataract surgery in patients with anterior uveitis in the Pakistani population.

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METHODOLOGY

This prospective observational cohort study was conducted at Layton Rahmatullah Benevolent Trust (LRBT) Tertiary Teaching Eye Hospital from June 2023 to May 2024. Patients were recruited from the uveitis clinic after obtaining approval from the ethical review board (REF letter No. LRBT/TTEH/ERC/4502/15) and a written informed consent from patients. A total of 65 consecutive patients with cataracts secondary to anterior uveitis were included in the study. A control group of non-uveitic cataract patients was not included, as the primary objective of this study was to specifically evaluate surgical outcomes in anterior uveitis.

Patients were categorized into four main groups based on the etiology of anterior uveitis; Idiopathic anterior uveitis, Fuchs' heterochromic iridocyclitis, Non-infectious anterior uveitis (secondary to autoimmune diseases) and Infectious anterior uveitis (limited to viral etiologies: herpes simplex virus (HSV), varicella-zoster virus (VZV), and cytomegalovirus (CMV) Viral anterior uveitis (HSV, VZV, CMV) was diagnosed on clinical grounds, as PCR testing was not routinely available in our setting.

Patients were included in the study if they met the following criteria: Presence of a significant cataract impairing vision and obstructing adequate visualisation of the posterior segment. The patient had well-controlled intraocular inflammation, with no signs of active disease for at least three months before surgery. Patients were excluded if they met any of the following criteria: Anterior uveitis caused by bacterial, fungal, or parasitic infections, as these etiologies were either associated with concurrent intermediate or posterior uveitis or subsequently developed posterior segment involvement; Presence of retinal or choroidal diseases that could influence retinal thickness and visual acuity, and history of prior ocular surgery or trauma.

The sample size was determined by using the single population proportion formula. In light of this, P = 79.7% [11], where "P" denotes the percentage of patients who achieved a best-corrected visual acuity (BCVA) of 6/15 or better after cataract surgery. With a 5% level of significance (α) and a 10% margin of error, the final sample size calculated was 62 patients, using OpenEpi Version 3.01 statistical software. To account for potential dropouts, non-responses, or data loss, an additional 5% was added to the sample size; thus, the final sample size was increased to 65 patients, who were included from the uveitis clinic at LRBT Tertiary Teaching Eye Hospital, Korangi, Karachi.

Data were collected at follow-up visits conducted at 1 week, 1 month, and 6 months post-operatively through direct, face-to-face clinical evaluations by the attending ophthalmologists. At each follow-up, Best-corrected visual acuity (BCVA) was measured. Anterior chamber cells and flare were analysed and graded according to the SUN classification [3]. Anterior and posterior segment examinations, including applanation tonometry, were performed. Pre-operative complications, including corneal opacity, pupillary membrane, posterior synechiae, peripheral anterior synechiae, cystoid macular edema, and glaucoma, were recorded. Common post-operative complications such as posterior capsular opacification, cystoid macular edema, epiretinal membrane, posterior synechiae, peripheral anterior synechiae, hypotony, recurrent uveitis, and corneal edema were documented.

A comprehensive ocular and medical history was obtained for each patient before cataract surgery. All patients underwent Visual acuity testing using the Snellen chart. Slit-lamp biomicroscopy with a 90-diopter lens. Applanation tonometry. Biometry, B-scan, and OCT (Heidelberg Engineering, Inc., Heidelberg, Germany) whenever indicated.

Systemic corticosteroids were initiated before surgery to ensure optimal inflammation control, thereby achieving the best possible surgical outcomes. Oral prednisolone was administered at a dose of 0.5 mg/kg/day for five days before the procedure.

Phacoemulsification was performed by the same surgeon in all patients. Ophthalmic viscosurgical devices (OVD) and iris retractors were used for synechiolysis. Each patient received a 5.5-6 mm single-piece foldable acrylic IOL (SA60AT AcrySof, Alcon Laboratories). After surgery, all patients were prescribed topical moxifloxacin 0.5% every 6 hours, topical prednisolone acetate 1% every 2 hours for 1 month and tapered according to the severity of inflammation, and cyclopentolate 1% every 12 hours. Additionally, all patients were given oral prednisolone at a dose of 0.5 mg/kg/day for 2 weeks and tapered over 6 weeks (30 mg/day for the first 2 weeks, 20 mg/day for the next 2 weeks, and 10 mg/day for the last 2 weeks), based on the severity of the inflammation Patients with a history of anterior uveitis who were already established on long-term systemic immunomodulatory therapy (*e.g.*, methotrexate) for disease control before enrollment continued this therapy throughout the perioperative period. The purpose was to maintain quiescence of the underlying inflammatory disease. Prophylactic topical non-steroidal anti-inflammatory drugs (NSAIDs) were not used in this population. Although prophylactic NSAIDs have been reported to reduce the risk of cystoid

macular edema, their additional benefit in uveitic cataract surgery remains debated, and perioperative corticosteroid therapy continues to be the cornerstone of inflammation control in our practice.

Statistical analysis was performed using SPSS (version 25). Descriptive statistics were presented as mean ± SD for continuous variables and frequency and percentage were computed for categorical variables. The Shapiro-Wilk test was used to assess the normality of the continuous variables. A repeated-measure ANOVA test was applied to compare intraocular pressure across different time intervals. A p-value less than 0.05 was considered statistically significant.

RESULTS

Demographic and Clinical Characteristics

In this study, 65 patients with nearly equal gender representation were included: 50.8% males and 49.2% females. The average age of patients was 43 ± 10.60 years, out of which 56.9% patients were aged 45 years and below, while the remaining 43.1% patients were older than 45 years. A total of 52.3% patients had involvement of the right eye, while left eye involvement was noted in 47.7% patients, as summarised in Table **1**.

Table 1: Demographic and clinical characteristics.

Gender	Frequency (%)
Male	33 (50.8)
Female	32 (49.2)
Age Group	
≤45 years	37 (56.9)
>45 years	28 (43.1)
Eye Involved	
Right	34 (52.3)
Left	31 (47.7)

With respect to the type of uveitis, as shown in **Fig. (1)**, 43.1% were diagnosed with idiopathic uveitis, 21.5% had non-infective uveitis, 18.5% had infective uveitis, and 16.9% had Fuchs' heterochromic anterior uveitis.

The most prevalent subtype of cataract was observed to be mixed cataract type, which was prevalent in 26 patients (40%), most frequently followed by posterior subcapsular cataract (PSC) in 24 patients (36.9%) and then by nuclear sclerotic (NS) cataract in 15 patients (23.1%). Other ocular findings were corneal opacities in 7 patients (10.8%), pupillary membranes in 34 (52.3%), synechiae in 46 patients (70.8%) posteriorly and in 14 patients (21.5%) anteriorly. Glaucomatous changes were noted in 24 (36.9%) as well. Cystoid macular edema (CME) was diagnosed in two patients (3.1%).

BCVA Trends Over Time by Uveitis Type

As shown in **Fig. (2)**, patients suffering from Fuchs' Heterochromic Iridocyclitis had the greatest and most lasting progress in visual acuity. Before surgery, their Best Corrected Visual Acuity (BCVA) was between 6/60 and 6/36, which was relatively low. A striking enhancement was noticed by a week post-surgery, with BCVA reaching roughly 6/18 to 6/12. After one month, vision was consistently around 6/9, and this level of visual acuity was sustained for six months, which indicates a positive long-term outcome.

Among patients with non-infective anterior uveitis, the preoperative BCVA was within the range of 6/60 to 6/36, which depicts moderate vision impairment. One week postoperatively, BCVA improved to 6/36 to 6/24. Further vision improvement was documented at one month, with vision reaching 6/18, while at six months, the vision stabilised at 6/18 to 6/12. These findings illustrate the positive effect of treatment over time.

For patients with idiopathic uveitis, preoperative BCVA ranged from 6/60 to 6/36, indicating moderate

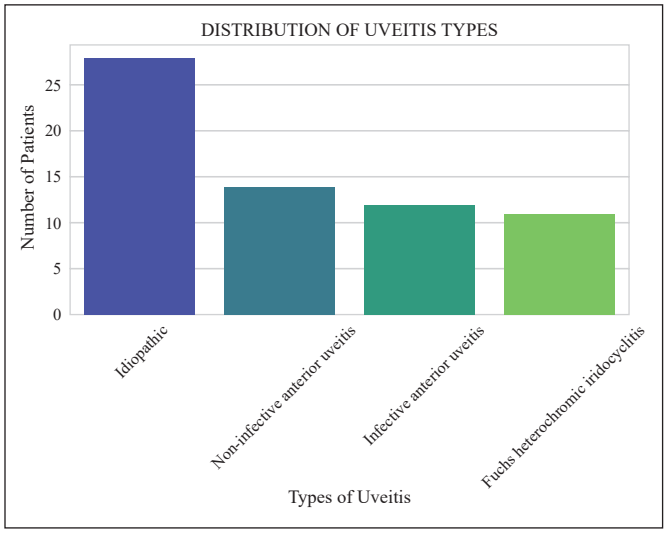

Fig. (1): Distribution of uveitis type.

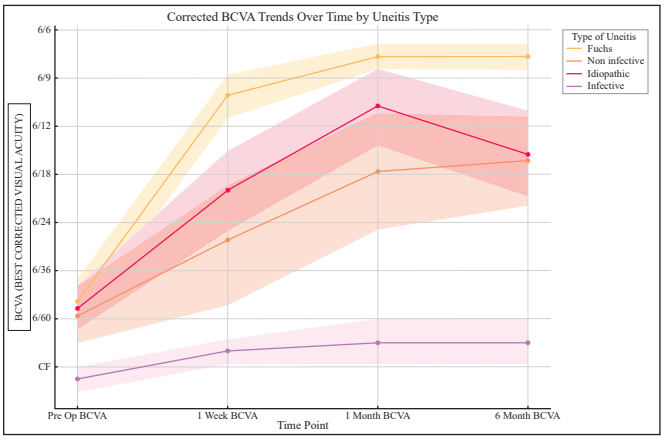

Fig. (2): BCVA over time by types of uveitis.

impairment. Slight improvement was observed by one week postoperatively, with BCVA reaching 6/36 to 6/24, and further improving to 6/18 by one month. However, by six months, vision had slightly regressed, stabilising at 6/24, indicating some variability in long-term visual outcomes.

Patients with infectious anterior uveitis (limited to HSV, VZV, and CMV due to their predominant anterior segment involvement) exhibited the poorest baseline visual acuity, typically at the level of Counting Fingers (CF). Although a slight improvement was observed within the first postoperative week, with vision increasing marginally but remaining between CF and 6/60, further progress was limited. By one month, best-corrected visual acuity (BCVA) remained at CF, with no significant improvement observed at six months, indicating progressive visual deterioration despite surgical intervention. This poor visual outcome might have been due to virus-induced damage to ocular structures, including corneal decompensation, chronic inflammation leading to optic nerve or macular involvement. Additionally, recurrent inflammatory episodes contributed to structural compromise, further limiting postoperative visual recovery.

Anterior Chamber (AC) Cells and Flare

Before surgery, no cells were present in the anterior chamber (A/C) of any of the patients. However, 12.3% of cases, which exhibited +1 cells, were identified as patients with Fuchs' Uveitis. One week after the operation, inflammation increased significantly, and only 9.2% of patients showed no cells. During this period, 29.2% of patients had moderate inflammation (grade 2+), and 10.8% had severe inflammation (grade 3+) according to the SUN classification. Patients showed a significant reduction in inflammation by the one-month mark, with 58.5% exhibiting no cells, followed by further reduction to 81.5% at six months. In summary, inflammation peaked one week postoperatively and gradually subsided by six months.

Most patients (84.6%) had no flare preoperatively. However, a week after the surgery, a marked increase was recorded as a positive flare response (Grade 1+) was noted in 53.8% of the patients. The inflammation reduced significantly with no flare in 89.2% of the patients by the one-month mark, which remained steady at 86.2% by the six-month mark. AC flares were noted to increase following surgery but reduce as time passes, suggesting that the blood-aqueous barrier heals over time, as shown in Table **2**.

Table 2: AC cells and AC flare.

Characteristics	Pre-op n(%)	1 Week n(%)	1 Month n(%)	6 Months n(%)
AC Cells				
0	54(83.1)	6(9.2)	38(58.5)	53(81.5)
0.5+	3(4.6)	12(18.5)	21(32.3)	8(12.3)
1+	8(12.3)	21(32.3)	6(9.2)	2(3.1)
2+	0(0)	19(29.2)	0(0)	2(3.1)
3+	0(0)	7(10.8)	0(0)	0(0)
AC Flare				
0	55(84.6)	30(46.2)	58(89.2)	56(86.2)
1+	10(15.4)	35(53.8)	7(10.8)	9(13.8)

Postoperative Complications

During follow-up visits, complications that were recorded included posterior capsular opacification (PCO), which increased in occurrence from 26.2% after one week to 40% by six months. Cystoid macular edema (CMO) was seen in 10.8% of patients after a week, and this number increased to 21.5% after a month and 27.7% after six months. The relatively high incidence of CMO observed in this study may, in part, be related to the non-use of prophylactic NSAIDs, which are reported in the literature to reduce the risk of CMO in high-risk patients. The proportion of patients with epiretinal membrane (ERM) increased from 4.6% after one week to 12.3% by six months. Patients with peripheral anterior synechiae were 16.9% at one week and increased to 24.6% at one and six months. Hypotony was present in 4.6% of patients at one week, but had fully resolved by one and six months. Recurrent uveitis impacted 3.1% of patients at one month, which increased to 12.3% by six months. Corneal edema, which was seen in 38.5% of subjects at one week, fully resolved by one month, as depicted in **Fig. (3)**.

Intraocular Pressure (IOP) Trends

As shown in **Fig. (4)**, mean IOP measurements were 16.56 ± 3.71 mmHg preoperatively, 17.02 ± 5.06 mmHg at one week, 16.58 ± 4.63 mmHg at one month, and 14.91 ± 3.26 mmHg at six months. The IOP changes within the early preoperative and postoperative phases were not significant; however, the six-month postoperative IOP reduction was significant ($p<0.001$).

DISCUSSION

The consequences of cataract surgery and intraocular lens (IOL) implantation for patients suffering from anterior uveitis are challenging because of the balance that exists between the irradiation of inflammation and the improvement of visual function. In this elucidative paper, we present the results of 65 cases of patients with

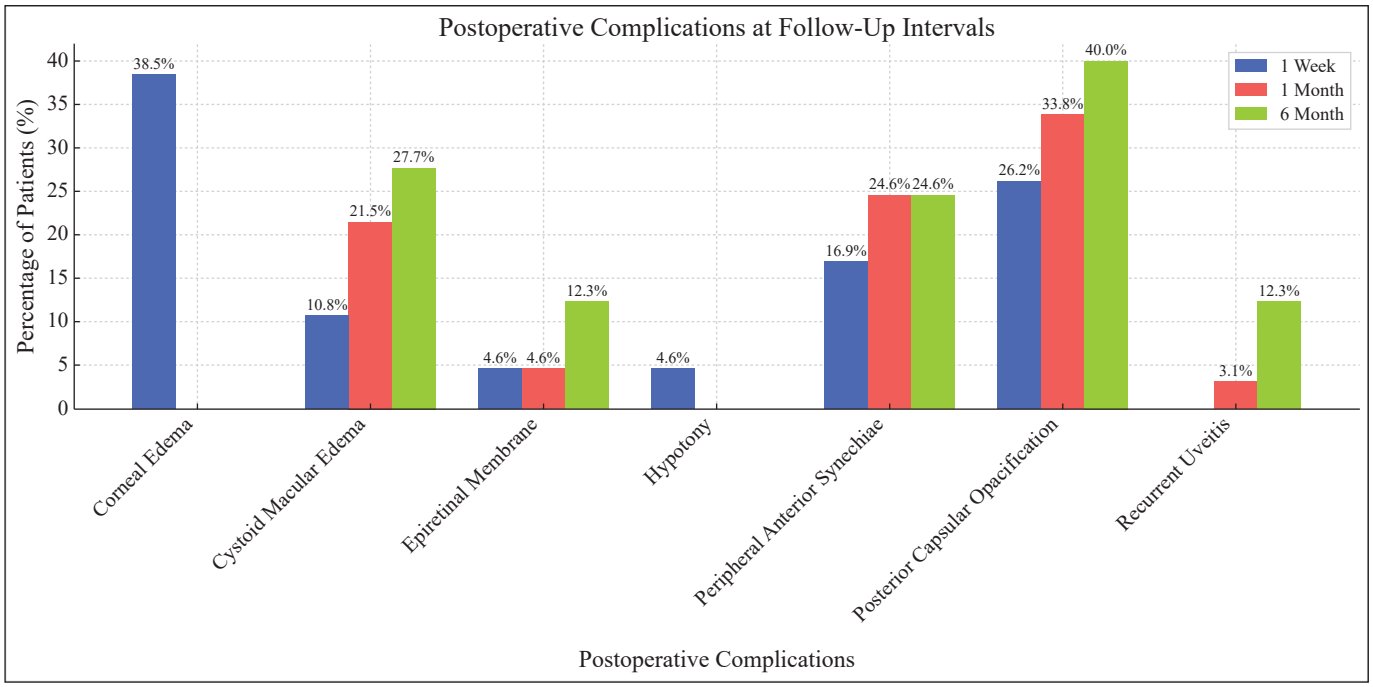

Fig. (3): Frequency of postoperative complications across different time intervals of the study.

a mean age of 43 years, their postoperative outcomes and complications. It demonstrates that although surgical treatment is associated with significant levels of visual acuity improvement across all subtypes of uveitis, the pattern of improvement, as well as the incidence of ocular surgical complications, varies with the etiology of anterior uveitis.

Postoperative visual outcome in this study was favourable, with a significant number of patients reaching a best-corrected visual acuity (BCVA) of 6/18 or better by the six months. This is consistent with a study on the effectiveness of cataract surgeries for uveitic cataracts; it described that most cases are likely to obtain normal or nearly normal visual acuity after surgery [10]. Similarly, Al-Ani *et al*. reported an outcome of achieving 20/50 or better visual acuity in 79.7% of the population at 12 months postoperatively [11]. This study highlights one crucial point of uveitic cataracts. Even though they are complex, they can achieve favourable visual recovery through meticulous surgical approaches as well as proper postoperative care.

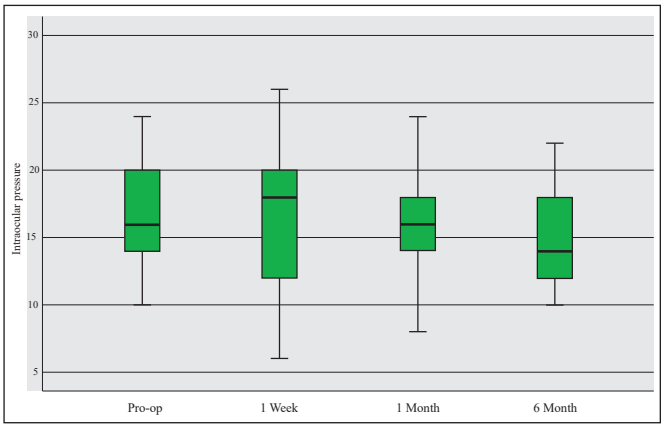

Fig. (4): Intraocular pressure trends across different time intervals of the study.

The results in this study were found to corroborate the literature suggesting that the best and most lasting postoperative visual outcomes are observed in patients with Fuchs' Heterochromic Iridocyclitis [12]. The visual outcome in this group improved from 6/60-6/36 to a steady proficiency of 6/9 six months postoperatively. The relatively mild inflammation associated with Fuchs' uveitis, especially during its chronic non-active phases, is likely to contribute to better surgical outcomes [13]. These features increase the likelihood of recovery without postoperative inflammatory complications, thereby distinguishing these patients from those with other forms of uveitis.

On the other hand, patients with idiopathic anterior uveitis sustained their initial improvement but had some fluctuations by the six-month mark. This is consistent with data indicating that patients with chronic or recurrent uveitis sustained inflammation should be expected to impact visual stabilisation [14]. Patients with infectious anterior uveitis (restricted to HSV, VZV, and CMV due to their primary involvement of the anterior segment) exhibited the poorest visual outcomes, with only slight improvement from CF to 6/60. The limited visual recovery is likely due to persistent intraocular

inflammation and structural damage to ocular tissues, a finding consistent with previous studies highlighting the challenge of visual rehabilitation in infectious uveitis [15]. This emphasises the need for aggressive and sustained anti-inflammatory management in infectious anterior uveitis to prevent irreversible structural damage and optimise functional outcomes.

In this study, one week postoperatively, the reaction of the anterior chamber peaked in patients, where 29.2% of patients had moderate (Grade 2+) inflammation. This postoperative inflammation is considered to be due to surgery, but data show that by six months, with 81.5% of patients having no cells, there is a steady decline in anterior chamber cells and flare. The same pattern of inflammation over time has been documented postoperatively, which highlights the need for careful control of the degree of inflammation during the perioperative period [16].

Posterior capsular opacification (PCO) was the commonest complication as anticipated, rising from 26.2% at one week to 40% at six months. This is consistent with a study where PCO was the most common late complication occurring in 53.3% of eyes [17]. Another study suggested that patients with uveitis have higher PCO rates because of increased inflammation, which induces faster proliferation of lens epithelial cells [18]. Cystoid macular edema (CME) was also common, with cases increasing from 10.8% at one week to 27.7% at six months. This progression is comparable with a report which noted macular edema in 26.6% of eyes after surgery [17]. The high CME rates need strong consideration for careful monitoring of the macula because severe inflammation may lead to macular vascular leakage and requires prompt treatment to avoid severe vision loss [19].

The development of Peripheral anterior synechiae (PAS) observed in 16.9% cases at one week increased to 24.6% at one and six months. This complication is associated with inflammation of the anterior segment and points towards the need for aggressive anti-inflammatory medications [20]. It is also encouraging to note that corneal edema, noted at one week, was completely resolved by one month. This indicates that appropriate medical treatment can facilitate the recovery of corneal endothelium.

In patients suffering from uveitis and scheduled for cataract surgery, managing intraocular pressure (IOP) is essential. Remarkably, in this study, the mean IOP was noted to remain unchanged from the preoperative to early postoperative period and showed a significant decrease at six months ($p < 0.001$). This is likely due to inflammation subsiding in conjunction with the reduction of corticosteroid dosage. Many other studies have documented the initial rise in IOP after surgery, which then subsequently normalises [17]. These results give rise to the conclusion that while it's expected to observe some short-term IOP increase, one needs to pay closer attention to preserving vision by individually-tailored reduction of steroid doses to avoid a long-term glaucomatous complication.

LIMITATIONS

This study has certain limitations. First, the sample size was relatively small, and the follow-up duration was limited to six months, which may not fully capture long-term outcomes and complications such as glaucoma or retinal detachment. Second, the absence of a control group of patients without uveitis undergoing cataract surgery prevents direct comparison of complication rates and visual results, though the primary aim was to report outcomes within a uveitic cohort. Finally, the study was conducted at a single centre with a predominantly South Asian population, which may affect the generalizability of the findings to other ethnic groups with different genetic predispositions and disease expressions.

CONCLUSION

With effective preoperative and postoperative inflammation control, good visual outcomes can be achieved in uveitis patients undergoing cataract surgery. However, postoperative success varies depending on the type of uveitis, with some patients recovering better than others. This study highlights the importance of frequent postoperative follow-up, close monitoring for inflammation, and judicious use of anti-inflammatory therapy to optimise surgical outcomes in patients with anterior uveitis.

ETHICAL APPROVAL

Ethical approval was obtained from the Ethical Review Committee of the Layton Rahmatulla Benevolent Trust (LRBT), Karachi (REF letter No. LRBT/TTEH/ERC/4502/15). All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/ or national research committee and the Helsinki Declaration.

CONSENT FOR PUBLICATION

Written informed consent was taken from the patients.

AVAILABILITY OF DATA

The data set may be acquired from the corresponding author upon a reasonable request.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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Declared none.

AUTHORS' CONTRIBUTION

R.A. (Rida Azeem): Conceived the study concept and design, and coordinated the overall research project.

S.N. (Saliha Naz): Contributed to manuscript revision and final proofreading.

U.N. (Uzma Naz): Drafted the initial manuscript and revised it critically for important intellectual content.

Z.K. (Zeeshan Kamil): Assisted with literature review, formatting, and final editing of the manuscript.

A.S. (Arfa Shaikh): Collected and organised the data, and contributed to data analysis and interpretation.

All authors read and approved the final manuscript and agree to be accountable for all aspects of the work.

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