Acta Scientific Ophthalmology (ISSN: 2582-3191)

Volume 7 Issue 11 November 2024

Research Article

Ophthalmic Outcomes Following Cataract Surgery Via Phacoemulsification in Patients with HIV, Hepatitis C, and Hepatitis B Compared to Seronegative Controls

Vartika Singh[1], Balbir Singh[2], Sanjay Goyal[1], Anand Aggarwal[1]*, Kamlinder Kaur[1], Amit Chopra[1], Indu Khosa[1], Divjot Kaur[1], Aman Kalia[1] and Akash[1]

[1]*Department of Ophthalmology, Government Medical College, Patiala, India*

[2]*Member Legislative Assembly and Honorable Health Minister, Vidhan Sabha Punjab, Chandigarh, India*

***Corresponding Author:** Anand Aggarwal, Cornea, Glaucoma and Refractive Surgery Services, Department of Ophthalmology, Government Medical College, Patiala, India.

Received: September 27, 2024

Published: October 30, 2024

Abstract

Introduction: Phacoemulsification is the standard treatment for cataract, systemic conditions such as HIV, HBV, and HCV can influence surgical outcomes. This study investigates the effectiveness and safety of phacoemulsification surgery in HIV, HBV, and HCV-positive patients compared to seronegative controls, focusing on visual acuity, intraocular pressure (IOP), and dry eye outcomes.

Methodology: A prospective case-control study was conducted at a tertiary care center in North India, involving 125 eyes from seropositive patients (HIV, HBV, HCV) and 50 eyes from seronegative controls. Patients aged 35-85 years with cataracts were included, while those with other ocular conditions or prior steroid use were excluded. Data collected included demographic details, serological status, CD4 counts, liver function tests, and fibrosis scores. Preoperative and postoperative assessments measured uncorrected (UCVA) and best-corrected visual acuity (BCVA), near vision, IOP, and Schirmer's test results over six months.

Results: Postoperative improvement in UCVA and BCVA was significant across all groups, with no significant differences between seropositive and control groups by day 180. Dry eye, assessed via Schirmer's test, showed significant reductions in seropositive groups compared to controls at all follow-up points ($p < 0.05$). IOP fluctuations were initially higher in HIV and HCV-positive patients but normalized by day 180. Astigmatism measurements remained comparable among all groups throughout the study.

Conclusion: Phacoemulsification surgery was equally effective in improving visual acuity in HIV, HBV, and HCV-positive patients as in seronegative controls. Despite initial variations in IOP and dry eye parameters, long-term visual outcomes were comparable across groups, suggesting that phacoemulsification is a safe option for cataract management in these seropositive immunocompromised patients.

Keywords: Cataract; Phacoemulsification; HIV; HBV; HCV

Introduction

The lens, a transparent structure behind the iris and in front of the vitreous body and retina, is essential for focusing light onto the retina. Loss of lens clarity results in cataracts, which cloud the eye's lens due to denatured proteins, reducing vision and potentially causing blindness [1]. The World Health Organization (WHO) reports that over 2.2 billion people globally suffer from vision impairment, with cataracts affecting 94 million individuals. Surgery, particularly phacoemulsification, is the primary treatment, utilizing small incisions and ultrasonic waves to extract the lens [2]. However, older age, systemic and ocular comorbidities, and surgical complications can lead to poor postoperative outcomes [3]. A compromised immune system during the perioperative period increases the risk of infections. Human immunodeficiency virus (HIV) targets the immune system, particularly CD4 T lymphocytes, leading to acquired immunodeficiency syndrome (AIDS) [4]. HIV/AIDS affects various body systems, including the eyes, where it can cause conditions like CMV retinitis, keratitis, dry eye, blepharitis, and uveitis [5]. The introduction of highly active antiretroviral therapy (HAART) has reduced mortality and opportunistic infections in HIV-positive individuals. Patients on antiretroviral therapy (ART) often experience accelerated aging, leading to early cataract

development and various metabolic disturbances, such as hyperlipidemia and insulin resistance, which also contribute to lens opacification [6,7]. Factors like CMV retinitis, reduced CD4+ cell count, and duration of HAART therapy are correlated with cataract development [8]. Hepatitis B (HBV) and hepatitis C virus' (HCV) primarily affect the liver, but they also affect the eyes and are linked to various ocular disorders, with keratoconjunctivitis sicca being a common manifestation. HBV and HCV can lead to cataract formation, especially in patients with significant liver fibrosis and inflammation, with high AST levels playing a role. HCV patients undergoing interferon treatment are at increased risk of age-related cataracts [9,10].

The effectiveness of phacoemulsification surgery in patients with HIV, HBV, and HCV is underexplored in India. This study aimed to evaluate visual and surgical outcomes in these patients, comparing them with seronegative individuals. By assessing postoperative results, including visual acuity improvements and complications, the research sought to provide insights into the safety and efficacy of phacoemulsification for seropositive patients in India.

Methodology

This prospective, case-control study recruited patients aged 35-85 years who were diagnosed with cataracts that reduced vision to at least 6/18 in the eye to be operated on and were seropositive for either HIV, HBV, or HCV, attending the outpatient Department of Ophthalmology at tertiary care centre in North India, after obtaining informed written consent, and the study received approval from the institutional ethics committee. The study included 125 eyes from seropositive patients and 50 eyes from control patients. The subjects were categorized into four groups: Group 1 consisted of HIV-positive patients (n = 50), Group 2 of Hepatitis C-positive patients (n = 50), Group 3 of Hepatitis B-positive patients (n = 25), and Group 4 of control patients (n = 50). Exclusion criteria included prolonged steroid treatment for reasons other than postoperative inflammation, undetermined anterior chamber status, a history of uveitis excluding CMVR, and any other combined ocular surgeries.

A comprehensive history was taken, covering gender, age at presentation, and systemic diseases. For HIV-positive patients, data on CD4 count, time since diagnosis, and viral load were collected. For HBV/HCV-positive patients, information on AST, ALT, platelet count, age, FIB-4 (fibrosis-4) index, and APRI score (AST to platelet ratio index) was obtained.

Visual acuity was recorded using Snellen's chart, noting both uncorrected (UCVA) and best-corrected visual acuity (BCVA). Postoperative visual acuity was assessed on day one, one month, six months. Patients were divided based on visual acuity into four categories: 6/6-6/9, 6/12-6/18,6/24-6/60, and <6/60). For near vision, patients were divided into four groups: N6, N8-N10, N12-N18, N24 and below. Dry eye disease was assessed using Schirmer's test, with a reading of less than 15mm indicating dry eye. Intraocular pressure (IOP) was measured using a non-contact tonometer (NCT), with post-operative measurements taken on the same schedule as visual acuity assessments. Keratometry was performed to measure the anterior corneal surface curvature and the axis of astigmatism, with pre-operative readings taken and follow-up at the same intervals as other post-operative assessments.

Statistical analysis

For the statistical analysis, data were collected and entered into Excel and analysed statistically using SPSS version 27.0 (SPSS; IBM Corp, NY). Categorical or classified data were analysed for association with seropositivity using the Chi-Square test or Fisher's exact test, as applicable. A significance level of $p < 0.05$ was used.

Results

A total of 125 seropositive eyes were recruited and were divided into three groups based on their diagnosis (Group 1-HIV reactive [n = 50]; Group 2- HCV positive [n = 50]; Group 3- HBV positive [n = 25]) and were compared with controls (n = 50). The demographic details have been summarised in Table 1. The mean age was 57.3 ± 9.1 years for HIV-positive patients, 61.14 ± 9.2 years for Hepatitis C patients, and 61 ± 9.7 years for the control group, with no significant difference among these groups. However, patients in Group 3 were significantly younger than the controls (p = .040).

Preoperatively, no patients had a UCVA of 6/6-6/9 or 6/12-6/18 across all groups. UCVA between 6/24-6/60 was observed in 34% of Group 1, 28% of Group 2, 36% of Group 3, and 32% of the control group. Most patients had UCVA worse than 6/60: 66% in Group 1, 72% in Group 2, 64% in Group 3, and 68% in the control group. On postoperative day 1, UCVA of 6/6-6/9 was achieved by 12% in Group 1, 10% in Group 2, 12% in Group 3, and 10% in controls. Most patients had UCVA of 6/12-6/18 (72% in Group 1, 74% in Group 2, 76% in Group 3, and 78% in controls). By day 30, 60% of Group 1, 64% of Group 2, 84% of Group 3, and 70% of controls achieved UCVA of 6/6-6/9. At day 180, the majority achieved UCVA of 6/6-6/9: 78% in Group 1, 82% in Group 2, 92% in Group 3, and 80% in controls, with no significant differences among groups at follow-up (Table 2).

	Group 1: HIV positive [n = 50]	Group 2: HCV positive [n = 50]	Group 3: HBV positive [n = 25]	Controls [n = 50]	p-value* (Group vs controls)
Mean age (years)	57.3 ± 9.1	61.14 ± 9.2	52.4 ± 10.52	61 ± 9.7 years	Group 1: .125; Group 2: .053;
Gender Males Females	 32 (64%) 18 (36%)	 23 (46%) 27 (54%)	 8 (32%) 17 (68%)	 30 (60%) 20 (40%)	 Group 1: .027; Group 2: .161;
Disease parameters	CD4 count(mean): 439 ± 145.26 cells/mm3;	ALT (IU/L):38.26 ± 24.2; AST (IU/L):38.94 ± 21.2 Platelet count (10^9/L): 240.22 ± 75.51 FIB-4: 1.80 ± .91 APRI: 0.48 ± .34	ALT (IU/L):44.2 ± 27.9; AST (IU/L):44.8 ± 25.6 Platelet count (10^9/L): 239 ± 74 FIB-4:1.72 ± .93 APRI:0.53 ± .38		
Systemic diseases					
Hypertension	6 (12%)	3 (6%)	4 (8%)	3 (12%)	
Type 2 diabetes	8 (16%)	6 (12%)	7 (14%)	3 (12%)	
Ocular diseases					
Retinal detachment	0 (0%)	1 (2%)	0 (0%)	0 (0%)	
Macular hole	0 (0%)	1 (2%)	0 (0%)	0 (0%)	
CME	1 (2%)	1 (2%)	0 (0%)	0 (0%)	
BRVO	1 (2%)	0 (0%)	1 (2%)	0 (0%)	
ARMD	1 (2%)	0 (0%)	0 (0%)	0 (0%)	
PED	0 (0%)	0 (0%)	1 (2%)	0 (0%)	
Intraoperative and post-operative complications					
PCR	3 (6%)	0 (0%)	1(2%)	1 (4%)	
Non-dilating pupil	2 (4%)	2 (4%)	2 (4%)	0 (0%)	
PCO	3 (6%)	1 (2%)	1 (2%)	2 (8%)	
Corneal edema	3 (6%)	6 (12%)	7 (14%)	5 (20%)	

Table 1: Demographic, systemic, ocular disease parameters, and intraoperative and postoperative complications among different group.

*p-value <0.05 is taken as significant; HIV: Human immunodeficiency virus; HCV: Hepatitis C virus; HBV: hepatitis B virus; ALT: Alanine transaminase; AST: Aspartate transaminase; FIB-4: Fibrosis-4 Index; APRI: Aspartate Aminotransferase to Platelet Ratio Index; CME: cystoid macular edema; BRVO: branch retinal vein occlusion; ARMD: age related macular degeneration, PED: pigment epithelial detachment, PCO: posterior capsule opacification.

		Group 1: HIV positive [n = 50]	Group 2: HCV positive [n = 50]	Group 3: HBV positive [n = 25]	Controls [n = 50]	p-value (Group vs control)
UCVA						
Pre-operative	6/6-6/9	0	0	0	0	Group 1: .832; Group 2: .663; Group 3: .729;
	6/12-6/18	0	0	0	0	
	6/24-6/60	17 (34%)	14 (28%)	9 (36%)	16 (32%)	
	<6/60	33 (66%)	36 (72%)	16 (34%)	34 (68%)	
POD1	6/6-6/9	6 (12%)	5 (10%)	3 (12%)	5 (10%)	Group 1:.530; Group 2: .844 Group 3: .965
	6/12-6/18	36 (72%)	37 (74%)	19 (76%)	39 (78%)	
	6/24-6/60	6 (12%)	8 (16%)	3 (12%)	6 (12%)	
	<6/60	2 (4%)	0	0	0	

POD 30	6/6-6/9	30 (60%)	32 (18%)	21 (84%)	35 (70%)	Group 1: .265; Group 2: .523 Group 3: .189;
	6/12-6/18	18 (36%)	18 (36%)	4 (16%)	15 (30%)	
	6/24-6/60	0	0	0	0	
	<6/60	2 (4%)	0	0	0	
POD 180	6/6-6/9	39 (78%)	41 (82%)	23 (92%)	40 (80%)	Group 1: .356; Group 2: .799; Group 3: .181;
	6/12-6/18	9 (18%)	9 (18%)	2 (8%)	10 (20%)	
	6/24-6/60	0	0	0	0	
	<6/60	2 (4%)	0	0	0	
BCVA						
Pre-operative	6/6-6/9	0	0	0	0	Group 1: .404; Group 2: .722; Group 3: .283;
	6/12-6/18	3 (6%)	10 (20%)	2 (8%)	7 (14%)	
	6/24-6/60	25 (50%)	21 (42%)	13 (52%)	22 (44%)	
	<6/60	22 (44%)	19 (38%)	10 (40%)	21 (42%)	
POD 1	6/6-6/9	29 (58%)	31 (62%)	15 (60%)	36 (72%)	Group 1: .235; Group 2: .392; Group 3: .071;
	6/12-6/18	18 (36%)	18 (36%)	10 (40%)	14 (28%)	
	6/24-6/60	1 (2%)	1 (2%)	0	0	
	<6/60	2 (4%)	0	0	0	
POD 30	6/6-6/9	46 (94%)	45 (90%)	23 (92%)	47 (94%)	Group 1: .223; Group 2: .461; Group 3: .743;
	6/12-6/18	01 (2%)	5 (10%)	2 (8%)	3 (6%)	
	6/24-6/60	0	0	0	0	
	<6/60	2 (4%)	0	0	0	
POD 180	6/6-6/9	48 (96%)	48 (96%)	23 (92%)	47 (94%)	Group 1: .082; Group 2: .646; Group 3: .743;
	6/12-6/18	0	2 (4%)	2 (8%)	3 (6%)	
	6/24-6/60	0	0	0	0	
	<6/60	2 (4%)	0	0	0	
Near vision						
Pre-operative	N6	3 (6%)	1 (2%)	0	3 (6%)	Group 1: .595; Group 2: .459; Group 3: .070;
	N8-N10	21 (42%)	32 (64%)	4 (16%)	26 (52%)	
	N12-N18	18 (36%)	12 (24%)	17 (68%)	17 (34%)	
	≤N24	8 (16%)	5 (10%)	4 (16%)	4 (8%)	
POD 1	N6	3 (6%)	6 (12%)	1 (4%)	2 (4%)	Group 1: .056; Group 2: .222; Group 3: .890;
	N8-N10	45 (90%)	41 (82%)	20 (80%)	42 (84%)	
	N12-N18	0	3 (6%)	4 (16%)	0	
	≤N24	0	0	0	0	
POD 30	N6	48 (96%)	48 (96%)	23 (92%)	47 (93%)	Group 1: .082; Group 2: .646; Group 3: .743
	N8-N10	0	0	2 (8%)	3 (6%)	
	N12-N18	0	0	0	0	
	≤N24	2 (4%)	2 (4%)	0	0	
POD 180	N6	48 (96%)	48 (96%)	23 (92%)	47 (93%)	Group 1: .082; Group 2: .646; Group 3: .743
	N8-N10	0	0	2 (8%)	3 (6%)	
	N12-N18	0	0	0	0	
	≤N24	2 (4%)	2 (4%)	0	0	

Table 2: Visual acuity (UCVA, BCVA and Near vision visual acuity) at follow-up points among different groups.

*p-value <0.05 is taken as significant; HIV: Human immunodeficiency virus; HCV: Hepatitis C virus; HBV: hepatitis B virus; POD: Post-operative day; UCVA: Uncorrected Visual Acuity; BCVA: Best Corrected Visual Acuity.

For Hepatitis C patients at day 180, 72% with FIB-4 <1.45 achieved UCVA of 6/6-6/9, compared to 92% with FIB-4 >1.45 (p = .066). For Hepatitis B patients, 100% with FIB-4 <1.45 achieved UCVA of 6/6-6/9, compared to 86.6% with FIB-4 >1.45 (p = 0.229). Based on APRI values, 82.9% of Hepatitis C patients with APRI <1.5 achieved UCVA of 6/6-6/9, versus 66.67% with APRI >1.5 (p = .476). Differences were not statistically significant.

Before surgery, no patients had a BCVA of 6/6-6/9. BCVA of 6/12-6/18 was found in 6% of Group 1, 20% of Group 2, 8% of Group 3, and 14% of controls. BCVA between 6/24-6/60 was noted in 50% of Group 1, 42% of Group 2, 52% of Group 3, and 44% of controls. BCVA worse than 6/60 was observed in 44% of Group 1, 38% of Group 2, 40% of Group 3, and 42% of controls. On the first postoperative day, BCVA of 6/6-6/9 was achieved by 58% in Group 1, 62% in Group 2, 60% in Group 3, and 72% in controls. BCVA between 6/12-6/18 was recorded in 36% of Groups 1 and 2, 40% of Group 3, and 28% of controls. BCVA between 6/24-6/60 was noted in 2% of Groups 1 and 2, with none in Group 3 or controls. BCVA worse than 6/60 was found in 4% of Group 1, with none in the other groups. By day 30, BCVA of 6/6-6/9 was seen in 94% of Group 1, 90% of Group 2, 92% of Group 3, and 94% of controls. BCVA of 6/12-6/18 was noted in 2% of Group 1, 10% of Group 2, 8% of Group 3, and 6% of controls. No patients had BCVA worse than 6/24-6/60, except 4% in Group 1 with worse than 6/60. By day 180, BCVA of 6/6-6/9 was observed in 96% of Groups 1 and 2, 92% of Group 3, and 94% of controls. BCVA of 6/12-6/18 was seen in 4% of Group 2, 8% of Group 3, and 6% of controls; only 4% in Group 1 had BCVA worse than 6/60. No significant differences were found between groups and controls at any follow-up (Table 2).

At day 180, 96% of Hepatitis C patients achieved a BCVA of 6/6-6/9 regardless of FIB-4 scores, with 4% in each group having a BCVA of 6/12-6/18 (p = .999). Among Hepatitis B patients, 100% with FIB-4 <1.45 achieved 6/6-6/9, compared to 86.6% with FIB-4 >1.45; 13.4% with higher FIB-4 had 6/12-6/18 (p = .229). No significant differences were found in BCVA outcomes based on FIB-4 scores. For APRI values, 95.7% of Hepatitis C patients with APRI <1.5 achieved 6/6-6/9, versus 100% with APRI >1.5 (p = .715). Only 4.3% with APRI <1.5 had 6/12-6/18. In Hepatitis B patients, 91.3% with APRI <1.5 achieved 6/6-6/9, compared to 100% with APRI >1.5 (p = .664). APRI values did not significantly affect visual outcomes in Hepatitis B and C patients at 180 POD.

Prior to surgery, 6% of patients in both Group 1 and the control group had near vision of N6, compared to 2% in Group 2, and none in Group 3. Near vision in the range of N8-N10 was seen in 42% of Group 1, 64% of Group 2, 16% of Group 3, and 52% of the control group. Near vision of N12-N18 was observed in 36% of Group 1, 24% of Group 2, 68% of Group 3, and 34% of the control group. Near vision worse than N24 was noted in 16% of Group 1, 10% of Group 2, 16% of Group 3, and 8% of the control group. On the first postoperative day, 6% of patients in Group 1, 12% in Group 2, 4% in Group 3, and 4% in the control group had near vision of N6. The near vision in the range of N8-N10 was observed in 90% in Group 1, 82% in Group 2, 80% in Group 3, and 84% in the control group. Near vision of N12-N18 was observed in 6% of Group 2, 16% of Group 3, and none in Group 1 or the control group. No patients had near vision worse than N24. By day 30, near vision of N6 was achieved by 96% of patients in both Group 1 and Group 2, 92% in Group 3, and 93% in the control group. Near vision in the range of N8-N10 was observed in none of Group 1 and Group 2, 8% of Group 3, and 6% of the control group. Near vision worse than N24 was observed in 4% of Group 1 and Group 2, and none in Group 3 or the control group. By day 180, near vision of N6 remained at 96% for Group 1 and Group 2, 92% for Group 3, and 93% for the control group. Near vision in the range of N8-N10 was observed in none of Group 1 and Group 2, 8% of Group 3, and 6% of the control group. Near vision worse than N24 was observed in 4% of Group 1 and Group 2, and none in Group 3 or the control group. The data for comparison of different groups with controls did not show any significance at baseline and subsequent post-operative follow-up.

Preoperatively, HIV patients had a mean IOP of 17.46 ± 3.42 mmHg. On POD 1, the mean IOP rose to 18.30 ± 3.35 mmHg (p = .035), indicating a significant increase. By POD 3, it decreased to 16.76 ± 2.84 mmHg (p = .010), showing a significant reduction. On POD 30 and POD 180, the mean IOP was 15.40 ± 2.14 mmHg (p = .104) and 15.18 ± 2.04 mmHg (p = .125), respectively, with no significant differences from the preoperative values. The mean IOP of Group 1 and the control group showed no significant differences (Table 3). For Group 2, the preoperative mean IOP was 16.62 ± 3.04 mmHg, compared to 16.08 ± 3.36 mmHg in the control group. On POD 1, Group 2's mean IOP increased to 17.58 ± 2.86 mmHg, while the control group's IOP rose more to 18.20 ± 2.68 mmHg. By POD 7, Group 2's mean IOP was 16.72 ± 2.43 mmHg, and the control group's IOP decreased to 15.40 ± 2.36 mmHg, with a significant p-value (<0.001). From POD 14 to POD 180, Group 2 consistently maintained higher mean IOP values than the control group, with all p-values remaining highly significant (<0.001). Group 3 had a preoperative mean IOP of 16.76 ± 3.15 mmHg, comparable to the controls (p = .961). On POD 1, Group 3's mean IOP was 17.96 ± 3.07 mmHg, slightly higher than the controls, but the difference was not significant (p = .729). From POD 3 to POD 180, there were no statistically significant differences in mean IOP between Group 3 and the controls.

	Group 1: HIV positive [n = 50]	Group 2: HCV positive [n = 50]	Group 3: HBV positive [n = 25]	Controls [n = 50]	p-value (Group vs control)
Mean IOP					
Pre-operative	17.46 ± 3.42	16.62 ± 3.04	16.76 ± 3.15	16.08 ± 3.36	Group 1: .333; Group 2: .780; Group 3: .961;
POD1	18.30 ± 3.35	17.58 ± 2.86	17.96 ± 3.07	18.20 ± 2.68	Group 1: .870; Group 2: .267; Group 3: .729;
POD 30	15.40 ± 2.14	16.26 ± 2.57	16.04 ± 2.77	14.74 ± 1.94	Group 1: .111; Group 2: .312; Group 3: .530;
POD 180	15.18 ± 2.04	16.20 ± 2.36	16.08 ± 3.14	15.00 ± 1.80	Group 1: .414; Group 2: .057; Group 3: .122;
Mean Schirmer's test					
Pre-operative	18.96 ± 6.39	18.00 ± 5.71	18.72 ± 5.76	21.70 ± 3.29	Group 1: .009; Group 2: <.001; Group 3: .023;
POD1	15.68 ± 5.74	14.34 ± 5.41	14.40 ± 5.02	18.50 ± 3.63	Group 1: .005; Group 2: <.001; Group 3: <.001;
POD 30	17.00 ± 5.35	15.16 ± 4.90	15.36 ± 4.45	18.66 ± 3.07	Group 1: .049; Group 2: <.001; Group 3: <.001;
POD 180	18.14 ± 5.11	16.42 ± 4.89	16.64 ± 4.09	20.64 ± 2.92	Group 1: .003; Group 2: <.001; Group 3: <.001;
Mean Astigmatism					
Pre-operative	0.60 ± 0.29	0.96 ± 0.70	0.92 ± 0.33	1.04 ± 1.00	Group 1: .056; Group 2: .220;01 Group 3: .061
POD1	0.82 ± 0.42	0.86 ± 0.38	0.91 ± 0.28	0.76 ± 0.46	Group 1: .501; Group 2: .248; Group 3: .101;
POD 30	0.53 ± 0.32	0.86 ± 0.38	0.61 ± 0.34	0.50 ± 0.42	Group 1: .696; Group 2: .646; Group 3: .237;
POD 180	0.45 ± 0.28	0.52 ± 0.36	0.42 ± 0.34	0.47 ± 0.40	Group 1: .719; Group 2: .646; Group 3: .615;

Table 3: Comparison of Ophthalmic parameters (mean intraocular pressure, Schirmer's test results, and mean astigmatism) across groups.

*p-value <0.05 is taken as significant; HIV: Human immunodeficiency virus; HCV: Hepatitis C virus; HBV: hepatitis B virus; POD: Post-operative day; UCVA: Uncorrected Visual Acuity; BCVA: Best Corrected Visual Acuity; IOP: Intraocular pressure.

The mean pre-operative Schirmer's test results were 18.96 ± 6.39 mm in Group 1, 18.00 ± 5.71 mm in Group 2, 18.72 ± 5.76 mm in Group 3, and 21.70 ± 3.29 mm in the control group. The p-values were .009 for Group 1, <.001 for Group 2, and .023 for Group 3, indicating statistically significant differences compared to the control group. On POD1, the mean Schirmer's test results were 15.68 ± 5.74 mm in Group 1, 14.34 ± 5.41 mm in Group 2, 14.40 ± 5.02 mm in Group 3, and 18.50 ± 3.63 mm in the control group. The p-values were .005 for Group 1, <.001 for Group 2, and <.001 for Group 3, showing significant reductions compared to the control group. By POD30, the mean Schirmer's test results were 17.00 ± 5.35 mm in Group 1, 15.16 ± 4.90 mm in Group 2, 15.36 ± 4.45 mm in Group 3, and 18.66 ± 3.07 mm in the control group, with p-values of .049 for Group 1, <.001 for Group 2, and <.001 for Group 3, indicating continued significant differences. On POD180, the mean Schirmer's test results were 18.14 ± 5.11 mm in Group 1, 16.42 ± 4.89 mm in Group 2, 16.64 ± 4.09 mm in Group 3, and 20.64 ± 2.92 mm in the control group. The p-values were .003 for Group 1, <.001 for Group 2, and <.001 for Group 3, indicating significant differences from the control group.

The mean pre-operative astigmatism was 0.60 ± 0.29 D in Group 1, 0.96 ± 0.70 D in Group 2, 0.92 ± 0.33 D in Group 3, and 1.04 ± 1.00 D in the control group. On POD1, the mean astigmatism was 0.82 ± 0.42 D in Group 1, 0.86 ± 0.38 D in Group 2, 0.91 ± 0.28 D in Group 3, and 0.76 ± 0.46 D in the control group. By POD30, the mean astigmatism was 0.53 ± 0.32 D in Group 1, 0.86 ± 0.38 D in Group 2, 0.61 ± 0.34 D in Group 3, and 0.50 ± 0.42 D in the control group. On POD180, the mean astigmatism was 0.45 ± 0.28 D in Group 1, 0.52 ± 0.36 D in Group 2, 0.42 ± 0.34 D in Group 3, and 0.47 ± 0.40 D in the control group. The comparison of astigmatism between the groups and the control group showed no significant differences pre-operatively or at any of the follow-up points.

Discussion

Cataract is a leading cause of reversible vision loss worldwide, often restored through surgery that replaces the cloudy lens with an artificial one [1]. The National Blindness and Visual Impairment Survey (2015-2019) reported that cataracts cause visual impairment in 71.2% of individuals aged 50 and older and 25.4% of those aged 0-49.

In 2022, the World Health Organization (WHO) reported that 39.0 million people globally were living with HIV, with an estimated 0.7% of adults aged 15–49 years affected, and 630,000 deaths from HIV-related illnesses. HIV infection is associated with significant ocular complications, affecting various ocular structures, including the adnexa, anterior and posterior segments, and orbit, leading to neuro-ophthalmological manifestations. There is growing evidence indicating a heightened risk of cataracts in HIV-infected patients. The use of antiretroviral therapy (ART) in HIV-infected individuals has increased life expectancy, leading to a rise in non-infective and non-AIDS-related conditions typically associated with aging [11]. A Danish nationwide cohort study demonstrated a higher risk of cataract development in individuals with a low CD4 cell count [12]. In our study, the average age of HIV-positive patients was 57.3 ± 9.1 years, ranging from 36 to 79 years, suggesting that cataracts may develop earlier in HIV-positive patients compared to seronegative individuals. Pathai., *et al*. found that only 58% of HIV-positive patients were below 50 years old, attributing this to accelerated aging in HIV-infected individuals [6].

The National Centre for Disease Control (2021) found that the national seroprevalence of HCV was 0.32%, while that of HBV was 0.95%. Chronic HCV infection frequently affects the ocular surface, with keratoconjunctivitis sicca being a common manifestation due to viral activity and immune responses. These mechanisms can also impact the posterior eye, causing retinopathy, papillitis, and neuritis [13]. Hepatitis virus infections and liver damage are highly associated with cataract formation. The risk of age-related cataract formation among patients infected with HBV or HCV may be influenced by the use of interferon for treatment [14].

This study concluded that there were no significant differences in UCVA and BCVA outcomes between the groups at any time point, indicating similar visual acuity improvements post-surgery, irrespective of seropositivity. Our findings are consistent with previous studies by Chew., *et al*. [15] Accorinti., *et al*. [7] and Sankaranan-than., *et al*. [16] which reported positive visual outcomes following cataract surgery in HIV patients. However, the presence of prior HIV-related uveitis or retinitis can influence the effectiveness of the procedure. A study by Christopher KL., *et al*. including 210 eyes of HCV-positive patients, found that while these patients were more likely to experience complications during cataract surgery, their final BCVA was excellent regardless of HCV status [17]. Additionally, neither FIB-4 values nor APRI scores significantly influenced visual outcomes among HCV and HBV patients at Day 180 post-surgery. Despite some differences observed in UCVA and BCVA between lower and higher FIB-4/APRI groups, these differences did not reach statistical significance. Therefore, liver fibrosis severity, as assessed by FIB-4 and APRI, does not appear to be a major determinant of visual recovery following cataract surgery in HCV and HBV patients.

Postoperative IOP was significantly reduced in all groups up to day 180. Similar results were found by Friedman., *et al*. who reported a reduction in IOP after phacoemulsification cataract surgery in non-glaucomatous patients. This reduction in IOP post-surgery can be attributed to the posterior displacement of the posterior capsule following lens removal, dislodging the zonula over the ciliary body and widening Schlemm's canal, thus improving aqueous humor drainage, as suggested by Poley., *et al*. [18] Wang., *et al*. proposed that the ultrasounds used in the phacoemulsification procedure might cause a rise in anterior chamber pressure, producing inflammatory cytokines that stimulate metalloproteinase production and remodel the trabecular meshwork, facilitating humor drainage [19]. No significant differences in preoperative IOP were found between seropositive patients and controls. Postoperatively, while IOP fluctuations occurred, no significant differences were noted between groups at any time point. Both HIV-positive patients and controls experienced a transient increase in IOP in the early postoperative period, consistent with findings reported by Grzybowski., *et al*. who noted that early postoperative IOP elevation is often due to residual viscoelastic material and surgical techniques [20]. Park., *et al*. found no significant difference in IOP between HIV-infected patients treated with HAART and a control group [21].

Preoperatively, HIV-positive patients had significantly lower tear production than controls ($p = .009$). Postoperatively, both groups experienced significant decreases in tear production, with controls consistently showing lower values than HIV-positive patients at all time points ($p < .05$). While tear production gradually improved, HIV-positive patients showed slower recovery and remained significantly below baseline tear production. Geier., *et al*. demonstrated that decreased tear production occurs in 20% to 25% of HIV patients, with no correlation to CD4+ lymphocyte count or severity of HIV disease, underscoring the prevalence of this issue in HIV patients [22]. Similar findings were reported by Decarlo D., *et al*. and Lucca J., *et al*. further validating the association between HIV infection and dry eye disease [23,24].

In HCV-positive patients, preoperative tear production was significantly lower (18.00 ± 5.71 mm) compared to controls (21.70 ± 3.29 mm, $p < .001$). Postoperatively, both groups showed a significant decrease in tear production at all time points, with cases consistently demonstrating lower values than controls. Overall, there was a consistent and significant decline in tear production for both groups following surgery, with the control group showing higher mean values and quicker recovery. Cacoub., *et al*. found that 10% of 312 HCV patients exhibited symptoms of xerostomia and/or xerophthalmia, highlighting the ocular surface as a significant site of manifestation in HCV-infected individuals [9]. Comparing Schirmer's test scores for HBV-positive patients and controls, preoperative and postoperative scores consistently showed HBV-positive patients had lower values than controls, with statistically significant differences ($p < .001$) at most visits. Wang., *et al*. reported a higher likelihood of chronic hepatitis B infection among patients with dry eye disease [25]. Our study also found that seropositivity does not affect astigmatism, and postoperative astigmatism reduction is mainly attributed to the intraoperative procedure of PCRI.

Our study has certain limitations, including a relatively small sample size. The presence of dry eye disease in seropositive patients was not thoroughly evaluated using other important parameters, such as tear breakup time (TBUT) and detailed symptomatic assessments through structured questionnaires like the ocular surface disease index (OSDI). Larger cohort studies with longer postoperative follow-ups are needed to provide a more robust assessment of cataract surgery outcomes in patients with HIV, Hepatitis B, and Hepatitis C infections and co-infections. This study, nevertheless, sheds a positive outlook on visual outcomes on these marginalised immunocompromised cohort of HIV, HBV or HCV positive patients.

Bibliography

1. Asbell PA., *et al*. "Age-related cataract". *The Lancet* 365.9459 (2005): 599-609.

2. Riaz Y., *et al*. "Surgical interventions for age-related cataract". *Cochrane Database System Review* 2006.4 (2006): CD001323.

3. Lai FHP., *et al*. "Clinical Outcomes of Cataract Surgery in Very Elderly Adults". *Journal of the American Geriatrics Society* 62.1 (2014): 165-170.

4. Govender RD., *et al*. "Global Epidemiology of HIV/AIDS: A Resurgence in North America and Europe". *The Journal of Epidemiology and Global Health* 11.3 (2021): 296-301.

5. Laovirojjanakul W and Thanathanee O. "Opportunistic ocular infections in the setting of HIV". *Current Opinion on Ophthalmology* 29.6 (2018): 558-565.

6. Pathai S., *et al*. "Increased ocular lens density in HIV-infected individuals with low nadir CD4 counts in South Africa: evidence of accelerated aging". *Journal of Acquired Immune Deficiency Syndromes* 63.3 (2013): 307-314.

7. Accorinti M., *et al*. "Cataract Surgery in HIV Seropositive Patients: Long-Term Follow-Up". *Ocular Immunology and Inflammation* 27.3 (2019): 435-446.

8. Giles K., *et al*. "Modified small incision cataract surgery and intraocular lens implantation in HIV Patients". *Ophthalmol Eye Disease* 7 (2015): 35-37.

9. Cacoub P., *et al*. "Extrahepatic manifestations associated with hepatitis C virus infection: a prospective multicenter study of 321 patients". *Medicine* 79.1 (2000): 47-56.

10. Park S and Choi N-K. "Hepatitis virus infection and age-related cataract". *Scientific Report* 7.1 (2017): 13089.

11. Agarwal A., *et al*. "Ocular Manifestations in Patients with Human Immunodeficiency Virus Infection in the Pre-HAART Versus the HAART Era in the North Indian Population". *Ocular Immunology and Inflammation* 25.3 (2017): 396-404.

12. Rasmussen LD., *et al*. "Risk of cataract surgery in HIV-infected individuals: a Danish nationwide population-based cohort study". *Clinical Infectious Disease* 53.11 (2011): 1156-1163.

13. O'Day R. "Ophthalmologic complications of antiviral therapy in hepatitis C treatment". *World Journal of Gastroenterology* 19.45 (2013): 8227.

14. Tsoumani A TVKKAITE. "Treatment and non-treatment related ocular manifestations in patients with chronic hepatitis B or C". *European Review for Medical and Pharmacological Sciences* 17.8 (2013): 1123-1131.

15. Chew GWM., *et al*. "Analysis and Outcomes of Cataract Surgery in Patients with Acquired Immunodeficiency Syndrome". *Ocular Immunology and Inflammation* 25.4 (2017): 535-539.

16. Sankarananthan R., *et al*. "Outcomes of cataract surgery in patients with Human Immunodeficiency Virus infection in a developing country". *International Ophthalmology* 43.5 (2022): 1601-1609.

17. Christopher KL., *et al*. "Outcomes and Risk Factors for Complications in Cataract Patients with Hepatitis C Virus Infection". *Ophthalmic Epidemiology* 30.5 (2023): 492-498.

18. Poley BJ., *et al*. "Long-term effects of phacoemulsification with intraocular lens implantation in normotensive and ocular hypertensive eyes". *Journal of Cataract and Refractive Surgery* 34.5 (2008): 735-742.

19. Wang N., *et al*. "Ultrasound activates the TM ELAM-1/IL-1/NF-kappaB response: a potential mechanism for intraocular pressure reduction after phacoemulsification". *Investigative Ophthalmology and Visual Science* 44.5 (2003): 1977-1981.

20. Grzybowski A and Kanclerz P. "Early postoperative intraocular pressure elevation following cataract surgery". *Current Opinion on Ophthalmology* 30.1 (2019): 56-62.

21. Park RJ., *et al*. "Intraocular pressure in patients with human immunodeficiency virus and treated with highly active antiretroviral therapy". *American Journal of Ophthalmology* 136.2 (2002): 360-361.

22. Geier SA., *et al*. "Sicca Syndrome in Patients Infected with the Human Inununodeficiency Virus". *Ophthalmology* 102.9 (1995): 1319-1324.

23. DeCarlo DK., *et al*. "Dry eye among males infected with the human immunodeficiency virus". *Journal of the American Optometric Association* 66.9 (1995): 533-538.

24. Lucca JA., *et al*. "Keratoconjunctivitis sicca in female patients infected with human immunodeficiency virus". *CLAO Journal* 20.1 (1994): 49-51.

25. Wang T., *et al*. "Comorbidities of dry eye disease: a nationwide population-based study". *Acta Ophthalmology* 90.7 (2012): 663-668.