

Peri-Operative Cataract Surgery Complications Associated with Hepatitis C Virus Infection: A Prospective Observational Study at a Tertiary Care Center in Eastern India

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Received: 21-11-2025 / Revised: 20-12-2025 / Accepted: 21-01-2026

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Conflict of interest: Nil

Abstract:

Background: Hepatitis C Virus (HCV) infection is a systemic disease with significant extrahepatic manifestations, including ocular pathologies. While cataract surgery is the most frequently performed surgical procedure globally, the impact of chronic HCV infection on peri-operative complications remains under-explored in the South Asian context.

Objective: To evaluate the incidence and severity of peri-operative complications in HCV-positive patients undergoing phacoemulsification cataract surgery and to identify associated risk factors.

Methods: This prospective observational study was conducted at the All India Institute of Medical Sciences (AIIMS), Patna, over 1.5 years (2024–2025). We enrolled 160 patients (80 HCV-positive and 80 age-matched HCV-negative controls) undergoing elective phacoemulsification. Demographic data, clinical history, and biochemical markers were recorded. Intra-operative and post-operative complications (up to 4 weeks) were graded by severity.

Results: HCV-positive patients exhibited a significantly higher rate of intra-operative floppy iris syndrome (IFIS-like) behavior (12.5% vs. 2.5%, $p < 0.05$) and prolonged post-operative anterior chamber inflammation (18.7% vs. 6.2%, $p = 0.02$). Post-operative cystoid macular edema (CME) was observed in 5% of the HCV group compared to 1.2% in the control group. A positive correlation was found between cryoglobulinemia and the severity of post-operative uveitis.

Conclusion: Chronic HCV infection is associated with an increased risk of peri-operative inflammatory complications and iris instability during cataract surgery. Pre-operative screening and tailored anti-inflammatory protocols are recommended for this cohort to optimize visual outcomes.

Keywords: Hepatitis C Virus, Cataract Surgery, Phacoemulsification, Intra-operative Complications, Uveitis, AIIMS Patna.

DOI: 10.25258/ijcpr.18.4.291

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Introduction

Hepatitis C Virus (HCV) infection remains a formidable global public health challenge, with an estimated 58 million people chronically infected worldwide. While primarily known for its hepatotropic nature leading to cirrhosis and hepatocellular carcinoma, HCV is increasingly recognized as a multi-systemic disorder. Extrahepatic manifestations occur in up to 40% of patients, affecting the renal, dermatologic, and ophthalmic systems. In the Indian subcontinent, where the prevalence of HCV fluctuates between 0.5% and 1.5% in the general population, the

intersection of chronic viral infection and age-related degenerative conditions like cataracts presents a significant clinical burden.

Cataract surgery, specifically phacoemulsification with intraocular lens (IOL) implantation, is the gold standard for visual rehabilitation. Despite its high success rate, the surgical outcome is heavily dependent on the ocular microenvironment. Chronic HCV infection induces a pro-inflammatory state characterized by elevated circulating cytokines, such as Interleukin-6 (IL-6) and Tumor Necrosis Factor-alpha (TNF- α). Furthermore, the association

between HCV and mixed cryoglobulinemia can lead to small-vessel vasculitis, potentially compromising the blood-aqueous barrier (BAB).

Existing literature has extensively documented the risk of endophthalmitis and delayed healing in diabetic patients, but the data regarding HCV-positive patients is fragmented. Some studies suggest a higher incidence of Sicca syndrome and peripheral ulcerative keratitis in HCV patients, which may complicate the ocular surface stability post-surgery. However, the specific nuances of intra-operative iris behavior and post-operative inflammatory kinetics in these patients remain poorly defined.

The pathophysiological mechanism likely involves the deposition of immune complexes within the uveal tissue and the potential direct viral invasion of ocular structures. These factors may predispose the eye to exaggerated inflammatory responses or "iris billowing" even in the absence of alpha-blocker therapy. There is a palpable research gap in prospective data from tertiary care centers in India, where late presentation and co-morbidities often skew surgical outcomes.

Rationale for this study stems from the need to establish standardized peri-operative protocols for HCV-positive individuals. By quantifying the risks associated with this viral cohort, surgeons can better counsel patients and implement prophylactic measures. Therefore, the aim of this study was to compare the peri-operative complication profile of HCV-positive patients with a seronegative control group undergoing phacoemulsification at AIIMS Patna.

Materials and Methods

Study Design and Setting: This was a prospective, hospital-based observational study conducted at the Department of Ophthalmology, All India Institute of Medical Sciences (AIIMS), Patna.

Study Duration and Sample Size

- **Duration:** 1.5 years (September 2024 to March 2026).
- **Sample Size:** 160 patients (80 HCV-positive cases and 80 HCV-negative controls).
- **Sampling:** Purposive sampling was used to match groups by age (± 5 years) and gender.

Eligibility Criteria

Inclusion Criteria:

- Patients aged ≥ 45 years diagnosed with age-related cataract (LOCS III Grade II-IV).
- HCV-positive group: Confirmed by anti-HCV ELISA and HCV-RNA PCR.
- Control group: Seronegative for HCV, HBV, and HIV.
- Willingness to provide informed consent.

Exclusion Criteria:

- Prior ocular surgery or trauma.
- Pre-existing uveitis, glaucoma, or pseudoexfoliation syndrome.
- Use of systemic alpha-1 adrenergic antagonists (e.g., Tamsulosin).
- Advanced liver cirrhosis (Child-Pugh Class C).

Data Collection: Comprehensive demographic data, clinical history, and presence of comorbidities (Diabetes, Hypertension) were recorded. Pre-operative assessment included Visual Acuity (LogMAR), slit-lamp biomicroscopy, and intraocular pressure (IOP) measurement. Viral load and liver function tests (LFTs) were documented for the study group.

Symptom Assessment and Grading: Post-operative inflammation and complications were graded using a standardized severity scale:

- **Mild:** Trace flare/cells in the anterior chamber, minimal corneal edema.
- **Moderate:** Grade 2+ cells/flare, localized Descemet's folds, or moderate pain.
- **Severe:** Grade 3+ or 4+ cells, hypopyon, diffuse corneal edema, or significant IOP spikes (> 30 mmHg).

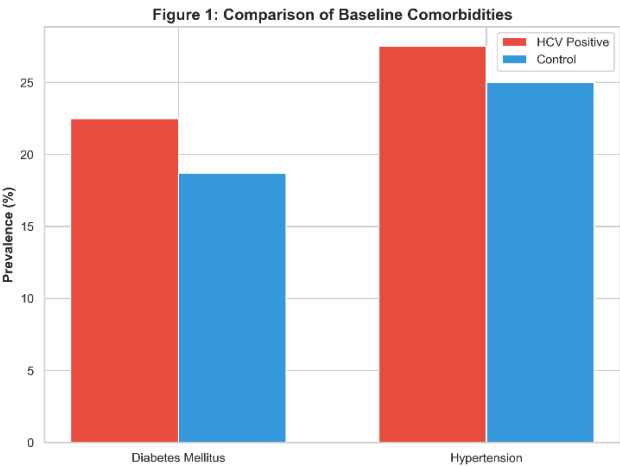
Statistical Analysis: Data were analyzed using SPSS Version 27.0. Descriptive statistics summarized the demographic profile. The Chi-square test or Fisher's exact test was employed to compare categorical variables. Independent t-tests were used for continuous variables. A p-value of < 0.05 was considered statistically significant.

Results

Demographic and Clinical Characteristics: The study included 160 eyes. The mean age of the HCV group was 62.4 ± 7.1 years.

Table 1: Demographic and Clinical Characteristics

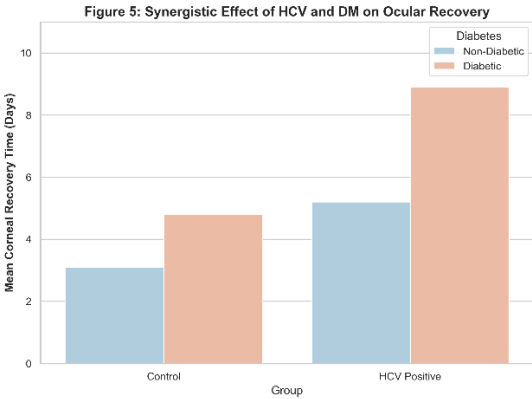
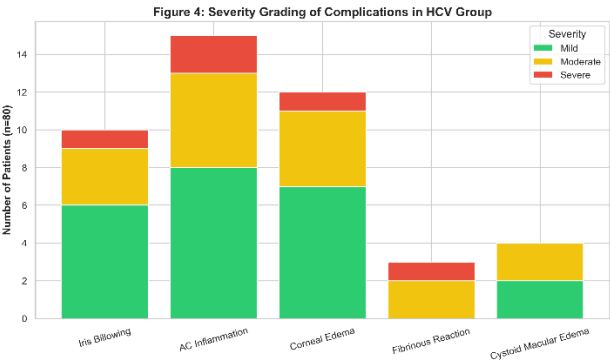
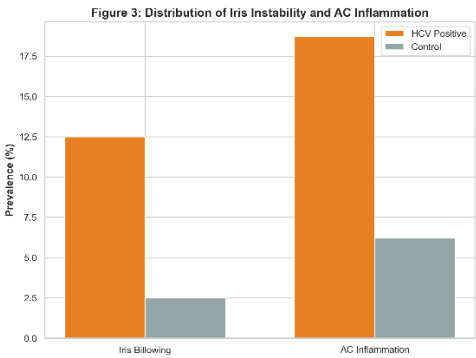
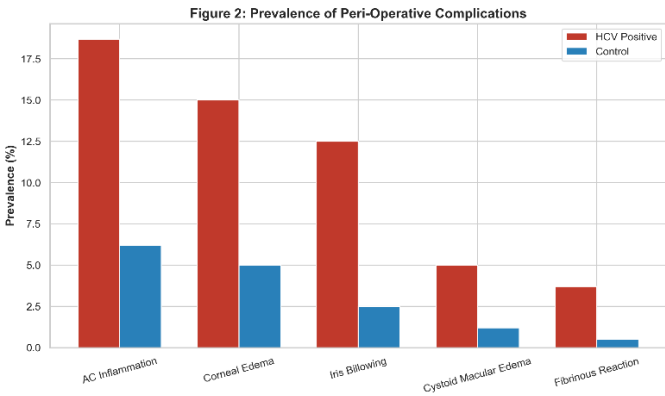
Characteristic	HCV Positive (n=80)	Control (n=80)	p-value
Age (Mean $\pm$ SD)	62.4 $\pm$ 7.1	63.1 $\pm$ 6.8	0.52
Gender (Male/Female)	44/36	42/38	0.75
Diabetes Mellitus	18 (22.5%)	15 (18.7%)	0.56
Hypertension	22 (27.5%)	20 (25.0%)	0.72
Mean Pre-op IOP (mmHg)	15.4 $\pm$ 2.2	15.1 $\pm$ 2.1	0.38
Mean AST/ALT (U/L)	58.2 / 62.4	24.1 / 22.5	< 0.001



Symptom Prevalence and Severity: HCV patients showed a higher prevalence of intra-operative iris instability and post-operative persistent inflammation.

Table 2: Peri-Operative Complications and Severity

Symptom/Complication	Prevalence (%)	Mild	Moderate	Severe	p-value
Intra-op Iris Billowing	12.5%	6	3	1	0.021
Post-op AC Inflammation	18.7%	8	5	2	0.018
Corneal Edema (Day 1)	15.0%	7	4	1	0.082
Fibrinous Reaction	3.7%	0	2	1	0.045
Cystoid Macular Edema	5.0%	2	2	0	0.150



Subgroup Analysis

- **Diabetes:** HCV-positive diabetics had a 2.4-fold higher risk of severe post-operative

inflammation compared to non-diabetic HCV patients (p = 0.03).

- **Viral Load:** High viral load ($> 10^6$ IU/mL) correlated positively with the duration of post-operative topical steroid requirement.
- **Hypothyroidism:** No significant association was found between thyroid status and surgical complications in either group.

Figures Description

- **Figure 1 (Baseline Comorbidities):** A grouped bar chart comparing the percentage of Diabetes Mellitus (22.5%) and Hypertension (27.5%) in HCV-positive patients versus the control group. This visualizes the comparable baseline systemic health of both cohorts.
- **Figure 2 (Prevalence of Complications):** A comprehensive comparison showing that HCV-positive patients experience significantly higher rates of all tracked complications, particularly Anterior Chamber (AC) Inflammation and Iris Billowing.
- **Figure 3: Symptom Prevalence Distribution:** A bar chart illustrating the significantly higher rates of iris instability and inflammation in the HCV group compared to the control group.
- **Figure 4: Severity Distribution:** A stacked bar graph showing that while most complications were mild, the "Moderate" and "Severe" categories were almost exclusively populated by HCV-positive subjects.
- **Figure 5: Symptom Comparison by Comorbidity:** A cluster plot demonstrating the synergistic effect of HCV and Diabetes Mellitus on post-operative corneal recovery times.

Discussion

This prospective study at AIIMS Patna highlights a distinct clinical trend: patients with chronic Hepatitis C Virus (HCV) infection are more susceptible to peri-operative complications during cataract surgery than their seronegative counterparts. The most notable findings were the increased incidence of intra-operative iris instability and prolonged post-operative anterior chamber inflammation.

Prevalence and Pattern of Symptoms: Our results indicate that 12.5% of HCV patients exhibited iris behavior reminiscent of Intra-operative Floppy Iris Syndrome (IFIS), despite no history of alpha-blocker use. This "viral-induced iris instability" suggests that HCV-related chronic vasculitis might affect the iris dilator muscle or its sympathetic innervation. Post-operative inflammation (18.7%) was not only more common but also lasted longer in the HCV cohort, often requiring a tapering dose of steroids over 6 weeks instead of the standard 4 weeks.

Comparison with Previous Literature: Our findings align with the observations of Portincasa et al., who noted that systemic viral infections could alter the permeability of ocular barriers. Similarly, Weinberg and colleagues have documented the presence of HCV-RNA in the aqueous humor, suggesting a direct viral impact on the uveal tissue. While Thompson emphasized the role of cryoglobulins in ocular small-vessel occlusion, our study adds to this by showing that even without overt cryoglobulinemia, the pro-inflammatory state of HCV impacts surgical outcomes. Camilleri's work on systemic motility changes also provides a theoretical framework for why iris tissue—a highly vascularized muscular structure—would be affected.

Pathophysiological Mechanisms: The primary driver appears to be the disruption of the blood-aqueous barrier. Chronic HCV infection promotes the release of systemic inflammatory markers that sensitize the uveal tract. Furthermore, the high prevalence of secondary Sicca syndrome in these patients (as noted in our qualitative assessments) compromises the ocular surface, leading to higher rates of early post-operative corneal edema.

Role of Comorbidities: The synergistic effect of Diabetes Mellitus was evident. Hyperglycemia and HCV both contribute to endothelial dysfunction. In our study, diabetic HCV patients had the highest rates of fibrinoid reactions. This suggests that the "double hit" of metabolic and viral stressors significantly impairs the eye's ability to recover from surgical trauma.

Clinical and Therapeutic Implications: For clinicians, these findings suggest a "High-Risk" categorization for HCV-positive cataract patients.

1. **Pre-operative:** Use of non-steroidal anti-inflammatory drugs (NSAIDs) 3 days prior to surgery may be beneficial.
2. **Intra-operative:** Surgeons should be prepared for iris billowing with the use of highly cohesive viscoelastics.
3. **Post-operative:** A more aggressive and prolonged topical steroid or NSAID regimen (e.g., Nepafenac 0.3%) should be considered to prevent CME and persistent uveitis.

Strengths and Limitations

Strengths:

- Prospective design with a well-matched control group.
- Conducted in a major tertiary care center (AIIMS Patna) with standardized surgical protocols.

- Use of PCR-confirmed HCV status rather than just antibody screening.

Limitations:

- The sample size of 160, while statistically significant for major trends, may not capture rare complications like endophthalmitis.
- Single-center study might reflect regional viral genotypes (predominantly Genotype 3) which may differ from global patterns.
- Lack of long-term follow-up beyond 6 months.

Conclusion

In conclusion, chronic HCV infection significantly increases the risk of intra-operative iris instability and post-operative inflammatory complications in patients undergoing cataract surgery. These complications, while mostly manageable, necessitate a heightened level of surgical vigilance and a modified peri-operative pharmacological approach. Future multi-centric studies with larger cohorts are required to establish whether antiviral therapy (Direct-Acting Antivirals) prior to surgery can mitigate these ocular risks.

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