ORIGINAL RESEARCH PAPER
Volume - 14 | Issue - 05 | May - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

COMPARATIVE ANALYSIS OF POSTOPERATIVE INTRAOCULAR PRESSURE AND CORNEAL ENDOTHELIAL CELL CHANGES WITH BALANCED SALT SOLUTION VERSUS OPHTHALMIC VISCOSURGICAL DEVICES ASSISTED INTRA OCULAR LENS IMPLANTATION DURING PHACOEMULSIFICATION SURGERY

Ophthalomology

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ABSTRACT

Background: Phacoemulsification along with intraocular lens implantation represents the standard surgical intervention for treating senile cataract. Ophthalmic viscosurgical devices (OVDs) together with balanced salt solution (BSS) play different roles in shaping postoperative intraocular pressure (IOP) and corneal endothelial cell count (ECC) during surgical procedures. This study compares the efficacy of BSS and OVDs during intra ocular lens implantation with respect to intra ocular pressure (IOP) and corneal endothelial changes postoperatively. **Methods:** The study examined 90 people getting intra ocular lens implantation by phacoemulsification surgery treatment through two groups named Group BSS and Group OVD. We documented both IOP and ECC (Endothelial cell count) measurements through the usage of applanation tonometry and specular microscopy respectively before surgery. The postoperative assessments for IOP was conducted on day 1 and week 1 and month 1 while ECC, CV (Coefficient of variation), HEX (Hexagonality) measurements took place at week 6. The study also monitored visual acuity through examinations of UCVA along with BCVA. **Results:** Patients in the OVD group experienced a significant pressure increase that reached statistical significance on both postoperative day one and week one when compared with the BSS group participants ($p < 0.001$ and $p = 0.005$, respectively). The three groups of ECC, CV, and HEX did not display meaningful changes between treatment groups at any assessment period. The surgical groups achieved equivalent achievements regarding visual acuity recovery after phacoemulsification. **Conclusion:** While OVDs lead to a temporary elevation in IOP, both BSS and OVDs are equally safe and effective in maintaining endothelial integrity and visual outcomes after phacoemulsification.

KEYWORDS

Phacoemulsification, Intraocular Pressure, Balanced Salt Solution, Ophthalmic Viscosurgical Devices, Corneal Endothelium

INTRODUCTION

Phacoemulsification has revolutionized cataract surgery, offering patients rapid visual recovery and minimal postoperative discomfort. The introduction of intraocular lenses (IOLs) further enhanced surgical outcomes, yet the tools and fluids used during the surgery continue to impact postoperative results. Among these, the intraoperative use of ophthalmic viscosurgical devices (OVDs) and balanced salt solution (BSS) significantly influences intraocular pressure (IOP) and corneal endothelial health [1].

OVDs provide anterior chamber stability, protect the endothelium, and facilitate capsulorhexis and IOL implantation [2]. However, they may elevate IOP if retained postoperatively [3]. BSS, in contrast, is a physiological irrigating solution less likely to cause IOP spikes but may offer less endothelial protection [4].

IOP fluctuations following surgery can influence both immediate and long-term outcomes, especially in patients with compromised optic nerves. Similarly, corneal endothelial cells are non-regenerative, and their loss may lead to corneal edema or decompensation [5,6]. Monitoring changes in ECC, hexagonality (HEX), and coefficient of variation (CV) provides insights into surgical trauma.

This study aims to compare postoperative IOP and corneal endothelial changes between BSS and OVD-assisted intra ocular lens implantation during phacoemulsification surgeries, contributing to the optimization of surgical protocols.

MATERIALS AND METHODS

Study Design And Setting

This prospective, interventional comparative study was conducted in the Department of Ophthalmology, SMS Medical College and hospital, Jaipur from December 1, 2022 to September 31, 2023, after obtaining approval from the Institutional Ethics Committee.

Sample Size Calculation

A total of 100 patients (50 per group) were enrolled, anticipating a 10% dropout, to detect a minimum 2 mmHg difference in postoperative IOP with an SD of 3.4 mmHg, at 95% confidence level and alpha error of 0.05.

Participants

Inclusion criteria were patients with senile nuclear cataract up to grade 2, clear corneas, and IOP < 20 mmHg. Exclusion criteria included diabetes, corneal pathologies, glaucoma, zonular weakness, trauma, or previous ocular surgery.

Surgical Technique

All surgeries were performed by a single experienced surgeon under topical anesthesia. After standard phacoemulsification using vertical chop technique, IOL was implanted using either BSS (Group 1) or OVD (Group 2) with complete removal of OVD if used. Incisions were sealed with stromal hydration, and intracameral moxifloxacin was injected.

Evaluation Parameters

- **IOP**: Measured preoperatively, day 1, week 1, and 1 month using applanation tonometry.
- **ECC, HEX, CV**: Measured preoperatively and at 6 weeks using specular microscopy.
- **UCVA And BCVA**: Measured at all follow-up visits.

Statistical Analysis

Data were analyzed using SPSS v22. Continuous variables were analyzed using t-tests; categorical variables were compared using Chi-square tests. $p < 0.05$ was considered statistically significant.

RESULTS

This section includes detailed observations from 90 patients (45 per group) who completed the follow-up.

A. Demographics: Mean ages were 62.33 ± 3.37 years (BSS) and 61.60 ± 4.27 years (OVD), with no significant age or gender differences between groups ($p > 0.05$).

B. Intraocular Pressure:

- On postoperative day 1, the OVD group exhibited a significantly higher IOP (18.13 ± 2.01 mmHg) compared to the BSS group (15.51 ± 1.56 mmHg, $p < 0.001$).
- At week 1, IOP remained higher in OVD ($p = 0.005$).

- By 1 month, differences were not statistically significant (p = 0.278).

C. Endothelial Cell Count And Morphology:

- No significant differences were observed in ECC, HEX, or CV preoperatively or at 6 weeks post-op (p > 0.05).

D. Visual Acuity:

- Both UCVA and BCVA improved significantly postoperatively in both groups.
- No statistically significant differences were noted between groups at any follow-up point (p > 0.05).**Tables and Figures**

Table 1: Demographic Characteristics of Study Participants

Parameter	BSS Group (n = 45)	OVD Group (n = 45)	P-value
Mean Age (years)	62.33 ± 3.37	61.60 ± 4.27	0.368 (NS)
Age Range (years)	57 – 70	55 – 70	
Female (%)	17 (37.77%)	18 (40.00%)	
Male (%)	28 (62.22%)	27 (60.00%)	

Table 2: Comparison of Intraocular Pressure (IOP) Between Groups

Time Point	BSS Group (Mean ± SD)	OVD Group (Mean ± SD)	P-value
Preoperative	14.98 ± 1.73 mmHg	14.67 ± 1.71 mmHg	0.392 (NS)
Post-op Day 1	15.51 ± 1.56 mmHg	18.13 ± 2.01 mmHg	<0.001 (S)
Post-op Week 1	13.58 ± 1.45 mmHg	14.36 ± 1.15 mmHg	0.005 (S)
Post-op Month 1	12.87 ± 1.14 mmHg	13.13 ± 1.18 mmHg	0.278 (NS)

Table 3: Corneal Endothelial Cell Parameters Preoperatively and at 6 Weeks Postoperatively

Parameter	BSS Pre-op	OVD Pre-op	BSS (6 Weeks)	OVD (6 Weeks)	P-value
Endothelial Cell Count	2678.24 ± 104.49	2630.36 ± 148.04	2380.49 ± 128.31	2354.96 ± 148.27	0.080 / 0.385 (NS)
Coefficient of Variation	35.68 ± 2.14	35.04 ± 1.84	38.78 ± 2.27	38.28 ± 2.04	0.131 / 0.279 (NS)
Hexagonality (%)	58.96 ± 3.97	58.82 ± 3.80	52.76 ± 3.84	53.07 ± 3.85	0.871 / 0.702 (NS)

Table 4: Visual Acuity Outcomes Over Time (logmar)

Time Point	UCVA (BSS)	UCVA (OVD)	P-value UCVA	BCVA (BSS)	BCVA (OVD)	P-value BCVA
Preoperative	0.58 ± 0.11	0.56 ± 0.12	0.465	0.41 ± 0.12	0.41 ± 0.11	0.985
Post-op Day 1	0.23 ± 0.07	0.23 ± 0.06	0.951	0.12 ± 0.10	0.14 ± 0.10	0.257
Post-op Week 1	0.23 ± 0.07	0.23 ± 0.06	0.951	0.04 ± 0.08	0.04 ± 0.08	1.000
Post-op Month 1	0.20 ± 0.11	0.18 ± 0.08	0.282	0.03 ± 0.07	0.04 ± 0.08	0.586
Post-op 6 Weeks	0.20 ± 0.11	0.18 ± 0.08	0.282	0.03 ± 0.07	0.04 ± 0.08	0.586

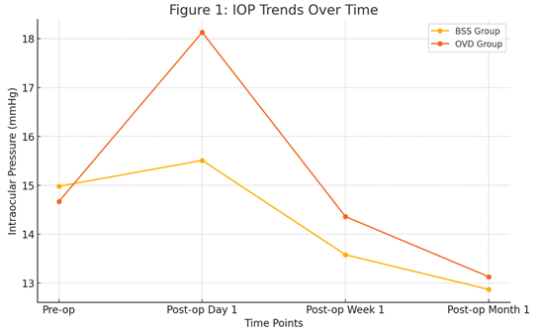

Figure 1: IOP Trends Over Time

IOP Trends Over Time - This graph shows the trends in Intraocular Pressure (IOP) over different time points for both the BSS and OVD groups.

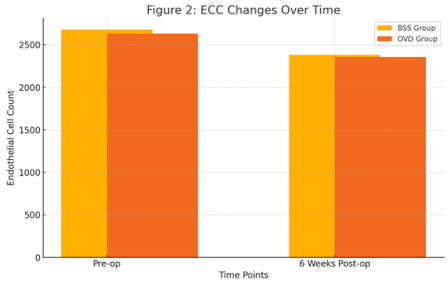

Figure 2: ECC Changes Over Time

ECC Changes Over Time - This graph depicts the changes in Endothelial Cell Count (ECC) from pre-operative to 6 weeks post-operative for both groups.

DISCUSSION

The postoperative course of IOP and corneal endothelial health is influenced by the surgical adjuncts used during phacoemulsification. This study clearly shows that the use of OVDs is associated with a transient rise in IOP, especially notable on postoperative day 1, corroborating findings from previous studies [3,4]. Retained viscoelastic material may occlude the trabecular meshwork, reducing aqueous outflow and leading to pressure spikes.

Contrastingly, BSS being physiologic and non-viscous, avoids such occlusion, thereby maintaining stable IOP. The current data highlight this advantage, especially for patients predisposed to glaucoma or with optic nerve vulnerabilities [5,7].

Despite these IOP differences, no significant variance was observed in ECC, HEX, or CV, aligning with research that suggests modern surgical techniques and prompt viscoelastic removal mitigate endothelial trauma [2,6].

Visual outcomes in terms of UCVA and BCVA were satisfactory and statistically equivalent between groups, suggesting that both techniques, when executed skillfully, offer excellent functional recovery [1,8].

Although this study controlled for major confounding variables and maintained surgical consistency, longer follow-up might be necessary to detect subtle long-term endothelial changes.

V. CONCLUSION

The use of BSS during intra ocular lens implantation in phacoemulsification offers a safe alternative to OVDs, especially in terms of early postoperative IOP control, without compromising corneal endothelial health or visual recovery. Choice of adjunct should be tailored based on patient profile and surgical considerations

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