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ORIGINAL ARTICLE

Comparison of Anti-Inflammatory Effects of Prednisolone versus Nepafenac 0.3% after Phacoemulsification and Intraocular Lens Implantation

Adnan Abdul Majeed, Fariha Sher Wali, Waqas Ali, Mohsin Iqbal, Asra Talpur, Sajjad Ali Surhio

Sindh Institute of Ophthalmology & Visual Sciences (SIOVS), Hyderabad, Pakistan.

Correspondence to: Dr. Adnan Abdul Majeed, Email: adnanbinabdulmajeedsanghar@gmail.com, ORCiD: 0000-0002-8576-3196

ABSTRACT

Objective: To compare the anti-inflammatory effects and safety profiles of prednisolone acetate 1% and nepafenac 0.3% in patients undergoing phacoemulsification with intraocular lens implantation (IOL).

Methods: This cross-sectional study was conducted at Sindh Institute of Ophthalmology and Visual Sciences, Hyderabad, Pakistan from December 2023 to July 2024. The study included patients underwent uneventful phacoemulsification with IOL implantation. Post-operative outcomes were assessed at a single follow-up conducted at 4 weeks. Primary efficacy endpoint was improvement in best-corrected visual acuity, measured as the reduction in Logarithmic Minimum angle of resolution (logMAR) values from baseline to follow-up. Clinically significant improvement was defined as a reduction of ≥0.2 logMAR units. Secondary outcomes included anterior chamber inflammation, graded using Standardization of Uveitis Nomenclature criteria, and incidence of adverse events.

Results: Of total 324 patients, mean age was 64.77 ±9.27 years. Mean logMAR change from baseline to follow-up was 0.28 ±0.11 units in the Prednisolone group and 0.30 ±0.11 units in the Nepafenac group, with statistically significant difference (p-value 0.050). The findings of clinical improvement, showed that 121 (48.8%) patients achieved clinical improvement in the Prednisolone group and 127 (51.2%) in the Nepafenac group. The distribution of inflammation grades (0, 1+, 2+, 3+), was similar between the Prednisolone and Nepafenac groups. A total of 76 (23.4%) adverse events were reported, with 40 (52.6%) occurring in the Prednisolone group and 36 (47.4%) in the Nepafenac group.

Conclusion: Both prednisolone acetate and nepafenac are effective and safe in managing post-operative inflammation and improving visual outcomes following phacoemulsification.

Keywords: Anti-Inflammatory Agents, Best-Corrected Visual Acuity, Non-Steroidal, Phacoemulsification, Postoperative Complications, Prednisolone Acetate.

INTRODUCTION

Cataract remains the leading cause of blindness worldwide, with surgical intervention being the definitive treatment to restore vision.[1,2] Phacoemulsification, a modern cataract extraction technique, is widely adopted due to its efficacy and safety profile.[3-5] However, the procedure can induce post-operative inflammation, potentially leading to complications such as cystoid macular edema (CME) and delayed visual recovery.[6] To mitigate these inflammatory responses, topical corticosteroids like prednisolone acetate 1% have been the cornerstone of post-operative management. Their potent anti-inflammatory effects are well-documented, but they carry risks, including elevated intraocular pressure (IOP) and delayed wound healing.[7,8] Alternatively, non-steroidal anti-inflammatory drugs (NSAIDs) such as nepafenac 0.1% have been employed to control inflammation with a potentially lower risk of increasing IOP. Nepafenac, a prodrug, penetrates ocular tissues effectively and is converted to amfenac, inhibiting prostaglandin synthesis and thereby reducing inflammation.[9] A study from Pakistan, conducted at the Pakistan Air Force Hospital Rafiqui, examined the use of nepafenac 0.1% and prednisolone acetate 1% for managing post-operative inflammation following cataract surgery, reflecting the focus on optimizing anti-inflammatory treatments in ophthalmology.[10] The study concluded that nepafenac was as effective as prednisolone in preventing post-operative inflammation, with no significant difference between the two treatments.

Despite these findings, there is limited data from the Sindh region of Pakistan, particularly from tertiary care centers like the Sindh Institute of Ophthalmology and Visual Sciences (SIOVS) in Hyderabad. Given the regional variations in patient demographics and clinical practices, it is essential to evaluate the comparative efficacy and safety of these treatments in our local population. This study aims to compare the anti-inflammatory effects of topical prednisolone acetate 1% and nepafenac 0.3% in patients undergoing phacoemulsification with intraocular lens implantation at SIOVS, Hyderabad. By assessing post-operative outcomes such as best-corrected visual acuity (BCVA), anterior chamber inflammation, and the incidence of complications, this research seeks to provide evidence-based recommendations for post-operative management in our specific patient population.

METHODS

This cross-sectional study was conducted at SIOVS, Hyderabad, Pakistan from December 2023 to July 2024. The study was approved by the institutional ethics review board at SIOVS (Reference Number: NO.SIOVS/EXEC.DIR/11372). Given the retrospective nature of the study, the ethics committee waived the requirement for individual informed consent. All data were anonymized to maintain patient confidentiality in accordance with the Declaration of Helsinki. Furthermore, the study adhered to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for reporting observational studies.

A total of 1703 patients who underwent phacoemulsification with intraocular lens implantation were screened for eligibility, and exclusions were applied based on predefined criteria, as detailed in the flowchart (Figure 1). The inclusion criteria were patients aged 50 to 80 years who underwent phacoemulsification, defined as a modern cataract removal technique using ultrasonic emulsification of the cloudy lens followed by intraocular lens implantation. Only patients with complete medical records documenting the administration of either prednisolone acetate 1% or nepafenac 0.3% as part of post-operative care were included. Prednisolone acetate 1% was defined as a corticosteroid in ophthalmic suspension form used topically to reduce inflammation by suppressing immune responses, and nepafenac 0.3% was defined as a non-steroidal anti-inflammatory drug in ophthalmic suspension form used to inhibit cyclooxygenase enzymes and reduce inflammation. Patients with a minimum of one month of follow-up records documenting post-operative outcomes were included.

Exclusion criteria included records with incomplete data, patients who received additional anti-inflammatory agents apart from the study drugs, pre-existing ocular inflammatory conditions such as uveitis or glaucoma, systemic conditions requiring immunosuppressive therapy, and intra-operative complications such as posterior capsular rupture.

Data collection focused on demographic variables, including age and sex. The primary efficacy endpoint was the improvement in BCVA, measured as the reduction in Logarithmic Minimum angle of resolution (logMAR) values from baseline to the post-operative follow-up visit. The findings of clinical improvement, defined as a reduction in logMAR of ≥0.2 units, which corresponds to gaining at least two lines of vision on a standard visual acuity chart. Furthermore, the reduction in post-operative inflammation and patient-reported symptoms at the follow-up visit was also observed.

Post-operative inflammation was operationally defined using the Standardization of Uveitis Nomenclature (SUN) criteria, which grades anterior chamber cell and flare reaction. Inflammation and symptoms were assessed during a single follow-up visit conducted at 4 weeks post-operatively. This follow-up interval was chosen to evaluate stabilized outcomes, allowing sufficient time for recovery while capturing the efficacy of the anti-inflammatory treatment. Adverse events were defined as complications such as persistent inflammation, corneal edema, or cystoid macular edema documented during the study period.

Data entry and analysis were performed using the Statistical Package for Social Sciences (SPSS) version 20.0. Mean ±SD was computed for quantitative variables like age and logMAR units, while frequency and percentages were computed for categorical variables like gender, adverse events, and inflammation grade, and clinical improvement. Inferential statistics were explored using Independent t-test test to compare logMAR visual acuity at baseline, follow-up, and mean change. The p-value of ≤0.05 was considered statistically significant.

RESULTS

Of total 324 patients, the mean age was 64.77 ±9.27 years. There were 147 (45.4%) males and 177 (54.6%) females. Patients were equally divided into two groups. At baseline, the BCVA, measured in logMAR, was almost similar between the Prednisolone group 0.66 ±0.21

units and the Nepafenac group 0.65 ±0.21 units, with no statistically significant difference (p-value 0.579). While at the follow-up, both groups showed substantial improvement in BCVA. The mean logMAR at follow-up was 0.38 ±0.21 units in the Prednisolone group and 0.34 ±0.22 units in the Nepafenac group. Although the Nepafenac group exhibited slightly better BCVA, the difference was not statistically significant (p-value 0.137). The mean change in logMAR, indicating improvement in visual acuity from baseline to follow-up, was 0.28 ±0.11 units in the Prednisolone group and 0.30 ±0.11 units in the Nepafenac group, with statistically significant difference (p-value 0.050) (Table 1).

The findings of clinical improvement showed that both treatments were effective in achieving clinically meaningful improvements in visual acuity post-operatively. In the Prednisolone group, 121 (48.8%) patients achieved clinical improvement, while in the Nepafenac group 127 (51.2%) patients achieved clinical improvement (Figure 2). The distribution of inflammation grades (0, 1+, 2+, 3+), was similar between the Prednisolone and Nepafenac groups. Complete resolution of inflammation (Grade 0) was observed in 35 (45.5%) of patients received Prednisolone and 42 (54.5%) of patients received Nepafenac.

Severe inflammation (Grade 3+) occurred in 36 (46.2%) of Prednisolone-treated patients and 42 (53.8%) of Nepafenac-treated patients. At the 4-week follow-up, a total of 76 (23.4%) adverse events were reported, with 40 (52.6%) occurring in the Prednisolone group and 36 (47.4%) in the Nepafenac group. The most common adverse event was mild, transient corneal edema, observed in 46 (60.5%) patients, 27 (58.7%) in Prednisolone group and 19 (41.3%) in Nepafenac group (Table 2).

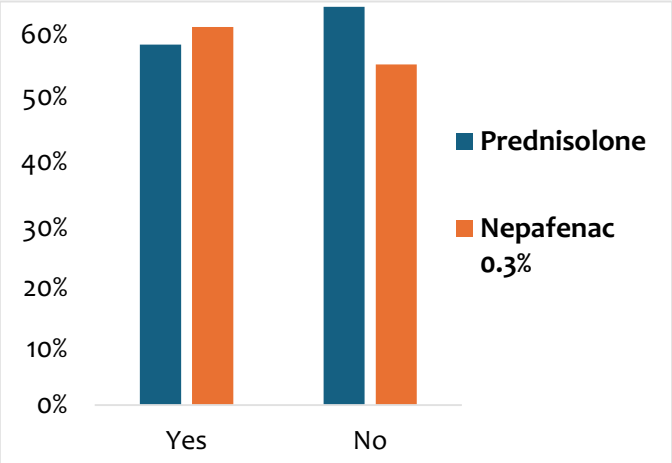

Figure 2: Patients achieving clinical improvement (reduction in logMAR ≥0.2) in the Prednisolone and Nepafenac 0.3% groups.

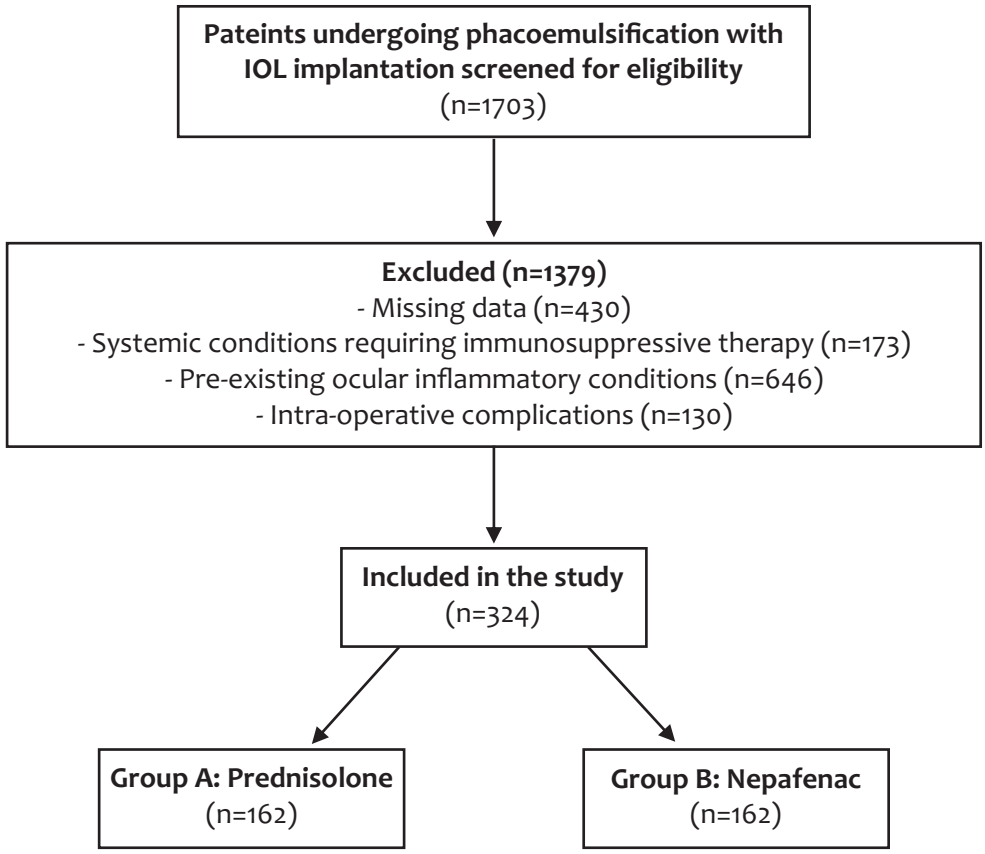

Figure 1: Flowchart illustrating the patient selection process

Table 1: Between group comparison of logMAR visual acuity at baseline, follow-up, and mean change (n=324)

	Total Mean ±SD	Prednisolone (n= 162) Mean ±SD	Nepafenac (n= 162) Mean ±SD	p-value	95% CI of the Diference
logMAR units at baseline	0.65 ±0.20	0.66 ±0.21	0.65 ±0.21	0.579	-0.03 to 0.06
logMAR units at follow-up	0.36 ±0.22	0.38 ±0.21	0.34 ±0.22	0.137	-0.01 to 0.08
Mean change in logMAR	0.29 ±0.10	0.28 ±0.11	0.30 ±0.11	0.050*	-0.04 to 0.01

- logMAR: Logarithmic Minimum angle of resolution, *p-value ≤0.05 (Independent t-test)

Table 2: Between group comparison of adverse events and inflammation grade (n=324)

	Total	Prednisolone (n= 162)	Nepafenac (n= 162)
Adverse Events			
Yes	76	40 (52.6)	36 (47.4)
No	248	122 (49.2)	126 (50.8)
Mild, Transient Corneal Edema			
Yes	46	27 (58.7)	19 (41.3)
No	33	16 (48.5)	17 (51.5)
Cystoid Macular Edema			
Yes	10	6 (60.0)	4 (40.0)
No	69	37 (53.6)	32 (46.4)
Persistent Inflammation			
Yes	30	16 (53.3)	14 (46.7)
No	49	27 (55.1)	22 (44.9)
Inflammation Grade			
0	77	35 (45.5)	42 (54.5)
1+	83	45 (54.2)	38 (45.8)
2+	86	46 (53.5)	40 (46.5)
3+	78	36 (46.2)	42 (53.8)

-All data reported as frequency (percentage)

DISCUSSION

Post-operative inflammation is a common concern following phacoemulsification, and effective management is crucial for optimal visual outcomes. In this study, we compared the efficacy of topical prednisolone acetate 1% and nepafenac 0.3% in controlling post-operative inflammation and improving BCVA at the 4-week follow-up. Our findings indicate that both prednisolone and nepafenac effectively reduce anterior chamber inflammation post-surgery. This aligns with previous studies, such as Sarkar *et al.* who reported comparable efficacy between nepafenac 0.1% and prednisolone acetate 1% in controlling post-operative inflammation after micro-incisional cataract surgery.[11] Similarly, a study by McCafferty *et al.* demonstrated that nepafenac 0.3% was non-inferior to prednisolone acetate 1% in preventing pseudophakic cystoid macular edema, underscoring the anti-inflammatory potential of nepafenac.[12]

Improvement in BCVA is a critical measure of surgical success. In our study, both treatment groups showed gains in BCVA, with statistically significant difference only in mean change in logMAR from baseline to follow-up. This is consistent with the results of Singhal *et al.* which found that nepafenac was as effective as prednisolone in enhancing visual outcomes post-cataract surgery.[13] Regarding safety, the incidence of adverse events such as mild, transient corneal edema and CME was comparable between the two groups. Notably, the Prednisolone group exhibited a slightly higher occurrence of these events. This observation is in line with the study by Nagpal *et al*. which reported similar safety profiles for nepafenac and prednisolone in post-operative management.[14] The comparable efficacy and safety profiles of nepafenac and prednisolone suggest that nepafenac can be a viable alternative to corticosteroids for post-operative inflammation management.[15-17] This is particularly relevant for patients at risk of steroid-induced intraocular pressure elevation or those with contraindications to steroids.[11,18-20]

This study has several limitations that should be acknowledged. First, the retrospective nature of the

research inherently limits the ability to establish causation between the interventions and outcomes. Retrospective studies rely on previously recorded data, which can be subject to inaccuracies or missing information. This limitation may have affected the precision and completeness of some variables, such as patient-reported symptoms or exact follow-up adherence. Second, the study was conducted at a single tertiary care center, SIOVS, Hyderabad, which may limit the generalizability of the findings to other settings or populations. Variability in surgical techniques, post-operative care, or patient demographics across different institutions might influence outcomes and reduce external validity. Third, the study employed only a single follow-up at 4 weeks, which does not capture long-term outcomes such as delayed complications, recurrence of inflammation, or sustained improvement in BCVA. Including additional follow-ups at 3 months or later could provide a more comprehensive understanding of the treatment effects.

Future research should focus on conducting randomized controlled trials (RCTs) to provide robust evidence on the comparative efficacy and safety of prednisolone acetate and nepafenac in managing post-operative inflammation after cataract surgery. A well-designed RCT would minimize bias, standardize treatment protocols, and allow for the accurate evaluation of outcomes. Additionally, expanding the study to include multiple centers across different regions of Pakistan or globally would enhance the generalizability of the findings, addressing variations in surgical techniques, patient demographics, and post-operative care practices. Longer follow-up periods, extending to 3 months or beyond, would be valuable in capturing long-term outcomes, including sustained improvements in BCVA and the occurrence of late-onset complications, such as cystoid macular edema. Future studies should also emphasize patient-centered outcomes, such as quality of life and visual satisfaction, to provide a more holistic assessment of treatment effectiveness. Furthermore, subgroup analyses based on factors like age, baseline visual acuity, or severity of inflammation could help identify specific populations that might benefit more from one treatment over the other. By addressing these aspects, future research can provide deeper insights into optimizing post-operative management strategies for cataract surgery patients.

CONCLUSION

Both nepafenac 0.3% and prednisolone acetate 1% are effective in controlling post-operative inflammation and improving visual acuity following phacoemulsification. Given their comparable efficacy and safety profiles, nepafenac presents a suitable alternative to corticosteroids in the post-operative management of cataract surgery patients.

ETHICAL APPROVAL: The study protocol was approved by the Ethical Review Board of Sindh Institute of Ophthalmology and Visual Sciences Hyderabad (Reference Number: NO.SIOVS/EXEC.DIR/11372, dated: 28 December, 2023)

AUTHORS' CONTRIBUTIONS: AAM & FSW: Substantial contributions to the conception or design of the work. AAM & WA: Data acquisition, analysis and interpretation. AAM, MI & AT: Drafting the manuscript or revising it critically for important intellectual content. AAM & SAS: Provided supervision and/or project administration. Including oversight of the research activity planning and execution. All authors critically reviewed and gave final approval of the manuscript.

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