

A STUDY COMPARING EFFECTIVENESS OF SUBTENON'S ANESTHESIA WITH PERIBULBAR ANESTHESIA IN PATIENTS UNDERGOING CATARACT SURGERY

Ophthalmology

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ABSTRACT

Background: Safe and effective regional anesthesia is important for providing analgesia and adequate operating conditions during cataract surgery. Sub-Tenon's anesthesia may reduce injection-related discomfort and pressure elevation, while peribulbar anesthesia may provide more profound akinesia. **Methods:** This prospective comparative observational study included 140 patients aged 30–70 years undergoing cataract surgery at J.L.N. Medical College and Hospital, Ajmer, between December 2023 and December 2024. Seventy patients received sub-Tenon's anesthesia and 70 received peribulbar anesthesia; each group included 35 phacoemulsification and 35 manual small-incision cataract surgery cases. Pain, akinesia, intraocular pressure (IOP), chemosis and subconjunctival hemorrhage (SCH) were compared. **Results:** Pain during administration was significantly lower with sub-Tenon's anesthesia. Intraoperative pain was comparable between groups, and postoperative pain at 2 hours was not significantly different. At 5 minutes, complete absence of movement was observed in 22% of the sub-Tenon's group versus 55% of the peribulbar group; at 10 minutes, the corresponding proportions were 50% and 82%. Mean IOP at 1 minute was 21.04 mmHg with sub-Tenon's and 27.62 mmHg with peribulbar anesthesia, with values approaching baseline by 10 minutes. Chemosis and SCH were significantly more frequent with sub-Tenon's anesthesia. **Conclusion:** Both techniques provided adequate anesthesia for cataract surgery. Sub-Tenon's anesthesia offered better injection-related comfort and a smaller transient IOP rise, whereas peribulbar anesthesia provided more profound akinesia. The higher frequency of chemosis and SCH with sub-Tenon's should be considered when selecting the anesthetic technique.

KEYWORDS

Sub-tenon's Anesthesia; Peribulbar Anesthesia; Cataract Surgery; Akinesia; Intraocular Pressure; Chemosis; Subconjunctival Hemorrhage

INTRODUCTION

Regional anesthesia for cataract surgery aims to provide adequate analgesia, control of globe and lid movement, favorable operating conditions and patient comfort while minimizing anesthesia-related complications. Peribulbar anesthesia is widely used and provides reliable sensory and motor blockade, but it requires a sharp needle and relatively larger volumes of local anesthetic. Sharp-needle orbital techniques are associated with potentially serious complications, while larger injected volumes may produce transient elevation of intraocular pressure.^{1,2,3,4}

Sub-Tenon's anesthesia provides local anesthetic through the potential space between Tenon's capsule and the sclera using a blunt cannula. The technique may provide effective analgesia with less injection-related discomfort and a smaller transient IOP rise. However, it may be associated with chemosis and subconjunctival hemorrhage, and residual ocular movements may occur.^{2,5,6,8,11}

The present study was undertaken to compare the effectiveness and safety of sub-Tenon's and peribulbar anesthesia in patients undergoing phacoemulsification or manual small-incision cataract surgery, with particular emphasis on pain, akinesia, IOP, chemosis and subconjunctival hemorrhage.

MATERIALS AND METHODS

Study Design and Setting

This prospective comparative observational study was conducted in the Department of Ophthalmology, J.L.N. Medical College and Hospital, Ajmer, Rajasthan, India. The study was conducted from December 2023 to December 2024 following approval from the institutional research review board and ethics committee (No.2429/ Acad-III/ MCA/ 2023) of J.L.N. Ajmer.

Inclusion and Exclusion Criteria

Patients aged 30–70 years undergoing cataract surgery were eligible. Patients with pre-existing ocular muscle paresis or neurological deficits, active ocular infection/inflammation, previous ocular trauma, conditions expected to prolong surgery such as lens subluxation or pupil size <5 mm, sensitivity to lignocaine or bupivacaine, need for general anesthesia, or significant systemic illness/debilitation were excluded.

Sample Size and Sampling

Sample of 68 cases was calculated at 95% confidence level and 10%

absolute error to verify the expected proportion of subconjunctival hemorrhage 77% in sub-tenon's anesthesia group. Here in this study of comparison between two groups, so sample size has been enhanced and rounded off to 70 cases for sub-tenon's group (Group S) and 70 cases for peribulbar group (Group P). This sample size is also adequate to cover all other study variables. Further to avoid any confounding factor, in each group out of 70 cases, 35 underwent phacoemulsification surgery and 35 underwent SICS. Convenient sampling was done for selection of the patients and the pretested questionnaire was used to assess demographic, personal and clinical profile of the patients.

Anesthetic Technique

In the sub-Tenon's group, topical anesthesia was followed by conjunctival/Tenon's entry and administering 3ml of study anesthetic into the sub-Tenon's space using a 26G, 2.5cm curved blunt cannula. In the peribulbar group, 5ml of local anesthetic was administered by a 24G, 2.5cm sharp-needle extraconal technique. The study protocol used smaller anesthetic volume for the sub-Tenon's technique than for the peribulbar technique.^{2,4,6,11}

Outcome Measures

Pain was assessed during administration of anesthesia, intraoperatively and 2 hours postoperatively using the study's categorical grading of no sensation, sensation/touch, mild pain, moderate pain and severe pain. Akinesia was assessed 5 and 10 minutes after anesthesia and categorized as no movement, reduced movement or complete movement. IOP was recorded preoperatively and at 1 and 10 minutes after administration of anesthesia. Chemosis and SCH were graded according to the number of conjunctival quadrants involved: none, one quadrant, two quadrants, or three to four quadrants.

Statistical Analysis

Data were entered into an Excel sheet. Quantitative variables were expressed as mean $\pm$ standard deviation and qualitative variables as proportions/percentages. Student's t-test was used for comparison of quantitative variables and chi-square testing for categorical variables. A p value <0.05 was considered statistically significant.

RESULTS

Baseline Characteristics

The mean age was 60.0 years in the sub-Tenon's group and 59.71 years in the peribulbar group, with no significant difference ($t=0.239$, $p=0.811$). The sex distribution was also comparable ($\chi^2=0.115$, $p=0.735$).

Table 1. Baseline Demographic and Surgical Characteristics.

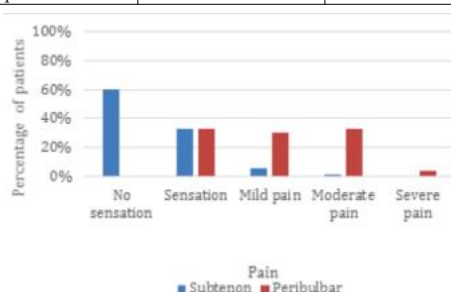
Characteristic	Sub-Tenon's (n=70)	Peribulbar (n=70)	p value
Mean age (years)	60.00	59.71	0.811
Male, n (%)	32 (45.71)	34 (48.57)	0.735
Female, n (%)	38 (54.29)	36 (51.43)	0.735
Phacoemulsification, n	35	35	—
SICS, n	35	35	—

Analgesia

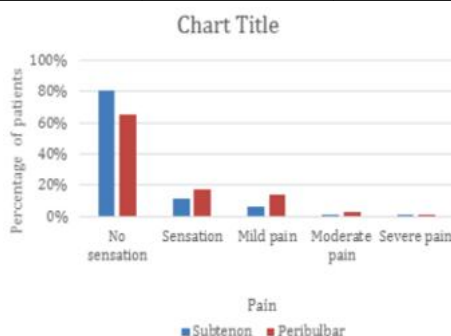
Pain during administration of anesthesia was significantly lower in the sub-Tenon's group ($\chi^2=97.83$, 4 df, $p=0.0001$). During surgery, 81% of patients in the sub-Tenon's group reported no sensation compared with 65% in the peribulbar group; the distribution remained statistically different ($\chi^2=13.24$, 4 df, $p=0.0102$). At 2 hours postoperatively, the difference was not statistically significant ($\chi^2=8.21$, 4 df, $p=0.0842$).

Table 2. Distribution of Analgesia During Anesthesia Administration

Pain category	Sub-Tenon's (%)	Peribulbar (%)
No sensation	60	33
Sensation/touch	33	33
Mild pain	5	30
Moderate pain	1	33
Severe pain	1	5

**Table 3. Distribution of Analgesia Intraoperative**

Pain category	Sub-Tenon's (%)	Peribulbar (%)
No sensation	81%	65%
Touch sensation	11%	17%
Mild pain	6%	14%
Moderate pain	1%	3%
Severe pain	1%	1%

**Table 4. Distribution of Analgesia 2 Hours Post Operative**

Pain category	Sub-Tenon's (%)	Peribulbar (%)
No sensation	86%	70%
Touch sensation	12%	25%
Mild pain	1%	1%
Moderate pain	1%	3%
Severe pain	0%	1%

Akinesia

At 5 minutes, 22% of patients in the sub-Tenon's group had no ocular movement compared with 55% in the peribulbar group, while 8% and 2%, respectively, had complete movement ($\chi^2=24.2$, 2 df, $p=0.00001$). At 10 minutes, no movement was recorded in 50% of the sub-Tenon's group and 82% of the peribulbar group; complete movement was seen in 6% and 1%, respectively. Although peribulbar anesthesia produced more profound akinesia, the thesis reports that residual partial movements after sub-Tenon's anesthesia did not interfere with the surgical steps.

Table 5. Akinesia 5 minutes after anesthesia.

Akinesia at 5min	Sub-Tenon's (%)	Peribulbar (%)
No movement	22	55
Reduced movement	70	43
Complete movement	8	2

Table 6. Akinesia 10 minutes after anesthesia

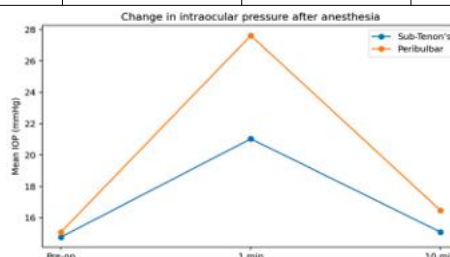
Akinesia at 10 min	Sub-Tenon's (%)	Peribulbar (%)
No movement	50	82
Reduced movement	44	17
Complete movement	6	1

Intraocular Pressure

Preoperative IOP was comparable between groups (14.78 ± 1.77 mmHg in the sub-Tenon's group versus 15.10 ± 1.57 mmHg in the peribulbar group; $t=-1.133$, $p=0.26$). At 1 minute, IOP was significantly lower after sub-Tenon's anesthesia (21.04 ± 2.26 mmHg) than after peribulbar anesthesia (27.62 ± 2.08 mmHg; $t=-17.92$, $p=0.0001$). At 10 minutes, IOP was 15.09 ± 1.36 mmHg and 16.47 ± 1.41 mmHg, respectively. The thesis reports that values approached the pre-injection level by 10 minutes.

Table 7. Intraocular Pressure Before and After Anesthesia.

Time point	Sub-Tenon's mean $\pm$ SD (mmHg)	Peribulbar mean $\pm$ SD (mmHg)	p value
Preoperative	14.78 ± 1.77	15.10 ± 1.57	0.26
1 min	21.04 ± 2.26	27.62 ± 2.08	0.0001
10 min	15.09 ± 1.36	16.47 ± 1.41	0.0001*

**Chemosis and Subconjunctival Hemorrhage**

Chemosis was significantly more frequent and extensive in the sub-Tenon's group ($\chi^2=52.34$, 3 df, $p=0.0001$). Only 15% of patients in the sub-Tenon's group had no chemosis compared with 65% in the peribulbar group. Similarly, SCH was significantly more common and extensive after sub-Tenon's anesthesia ($\chi^2=90.08$, 3 df, $p=0.0001$); 26% of sub-Tenon's patients had no SCH compared with 92% of peribulbar patients.

Table 8. Distribution of Chemosis.

Chemosis	Sub-Tenon's (%)	Peribulbar (%)
None	15	65
1 quadrant	44	20
2 quadrants	32	12
3-4 quadrants	9	3

Table 9. Distribution of Subconjunctival Hemorrhage

SCH	Sub-Tenon's (%)	Peribulbar (%)
None	26	92
1 quadrant	42	4
2 quadrants	24	3
3-4 quadrants	8	1

DISCUSSION

The present study demonstrates that both sub-Tenon's and peribulbar anesthesia can provide adequate anesthesia for cataract surgery, but their performance differs across specific outcomes. Sub-Tenon's anesthesia was associated with substantially less discomfort during administration and a smaller transient rise in IOP, whereas peribulbar anesthesia produced more complete globe akinesia. Sub-Tenon's anesthesia, however, was associated with considerably higher rates of chemosis and subconjunctival hemorrhage.

The lower injection-related pain observed with sub-Tenon's anesthesia is consistent with earlier comparative studies. Briggs et al. reported significantly lower pain scores during anesthetic administration with sub-Tenon's anesthesia, while Parkar et al. similarly found a greater proportion of patients to be pain-free during administration. Studies cited in the thesis also generally report comparable intraoperative

analgesia between the two techniques. The present findings are consistent with this pattern: the principal analgesic advantage of sub-Tenon's anesthesia was observed during administration, while intraoperative and early postoperative analgesia were broadly comparable.^{6,11,7,12}

Peribulbar anesthesia produced more profound akinesia in the present study. At 5 minutes, absence of movement was recorded in 55% of the peribulbar group versus 22% of the sub-Tenon's group, increasing to 82% versus 50% at 10 minutes. This finding is comparable with Parkar et al. and Channashetti et al., who reported greater absolute akinesia with peribulbar anesthesia. The residual movement associated with sub-Tenon's anesthesia may reflect diffusion from the sub-Tenon's space to the orbital compartments rather than direct delivery to the conal space. Importantly, the thesis reports that these partial movements did not interfere with the surgical steps and could be managed by patient cooperation and globe fixation.^{11,5}

The IOP findings are clinically relevant. The mean IOP increased from approximately 15 mmHg preoperatively to 21.04 mmHg after sub-Tenon's anesthesia and to 27.62 mmHg after peribulbar anesthesia at 1 minute. By 10 minutes, the values were close to baseline in both groups. Azmon et al. similarly reported a significant early IOP rise after peribulbar injection but not after sub-Tenon's injection, with return toward baseline by 10 minutes. The greater early rise with peribulbar anesthesia is plausibly related to the larger volume injected into the orbital space.^{8,9}

Chemosis and SCH were substantially more common with sub-Tenon's anesthesia. This is consistent with the mechanism of the technique, which requires conjunctival and Tenon's manipulation and may allow anterior tracking of anesthetic. Similar patterns have been reported in studies cited in the thesis, including Parkar et al. and Channashetti et al. Although cosmetically noticeable, these complications were described in the thesis as generally self-limiting and not interfering substantially with cataract surgery.^{5,17}

Taken together, the findings suggest that the choice of regional anesthesia should be individualized. Sub-Tenon's anesthesia may be particularly attractive when patient comfort, avoidance of a sharp orbital needle and limitation of acute IOP elevation are priorities. Peribulbar anesthesia remains advantageous when more profound globe immobility is desired. The present study also highlights that the greater local conjunctival morbidity of sub-Tenon's anesthesia should be discussed with patients.^{2,4,6,11}

CONCLUSION

Both sub-Tenon's and peribulbar anesthesia provided adequate anesthesia for cataract surgery. Sub-Tenon's anesthesia was associated with significantly less pain during administration and a smaller transient increase in IOP, while peribulbar anesthesia provided more profound akinesia. Chemosis and subconjunctival hemorrhage were significantly more frequent with sub-Tenon's anesthesia. Thus, sub-Tenon's anesthesia represents an effective alternative to peribulbar anesthesia when patient comfort, avoidance of sharp-needle complications and IOP control are prioritized, while peribulbar anesthesia may be preferred when maximal globe immobility is required.

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