



EFFECT OF ADDITION OF DEXAMETHASONE AS AN ADJUVANT TO LOCAL ANAESTHETIC IN PERIBULBAR BLOCK FOR CATARACT SURGERIES.

Anaesthesiology

Shwetha

Seetharamiah

MBBS, MD, Consultant, Janani Anesthesia and Critical care services

Abhishek Ravindra

MBBS, Junior Resident, Janani Anaesthesia and Critical care services

Kavitha V*

MBBS, DO, DNB Senior Consultant, Sankara Eye Hospital *Corresponding Author

Sandhya D

MBBS DNB, Assistant Professor, Subbaiah Institute of Medical & Dental Sciences

G L Ravindra

MBBS, MD, Chief Consultant, Janani Anesthesia and Critical care services

ABSTRACT

Aim: To compare the efficacy of two different doses of dexamethasone as an adjuvant to local anaesthetic on onset and duration of lid and globe akinesia, and postoperative analgesic requirement following cataract surgery in a tertiary eye hospital performing high volume blindness preventive surgeries.

Method: A prospective, longitudinal study was conducted among 120 patients of 40 - 85 years age, posted for small incision cataract surgery (SICS) under peribulbar block. Patients were allotted to three equal groups - LAO: Local Anesthetic only, LAD2: Local Anesthetic with dexamethasone 2 mg, and LAD4: Local Anesthetic with dexamethasone 4 mg. Onset and duration of lid and globe akinesia and postoperative analgesic requirement between the groups were compared.

Result: Median difference of lid and globe akinesia onset, globe akinesia duration and difference in proportion of postoperative analgesic request was statistically significant in group LAD4 (p value<0.001). Difference in median visual analogue score (VAS) at 2, 6 and 8 hours and postoperative analgesic requirement was statistically significant (p value<0.05) in LAD4 group when compared to LAD2 and LAO group.

Conclusion: Dexamethasone as an adjuvant to local anesthetic accelerates the onset of lid and globe akinesia, prolongs the duration of globe akinesia and reduces postoperative analgesic requirements thereby reducing morbidity. Dexamethasone 4 mg is more effective as compared to 2 mg.

KEYWORDS

cataract, dexamethasone, peribulbar-block, adjuvant, local-anesthesia

BACKGROUND:

Cataract is the most common cause of preventable blindness in developing countries. There are an estimated 95 million affected by cataract globally and this burden is more so in South Asia.^{1,2} The National Blindness Control Program goal is to reduce prevalence of blindness to 0.3% by 2020.³ This requires more state-of-art techniques to overcome the pain and morbidity associated with cataract surgery. Commonly used anesthetic techniques during cataract surgery include peribulbar block which offers the advantage of minimal hemodynamic disturbance compared to general anesthesia.^{4,5}

Local anesthetic (LA) drugs used in peribulbar block provide excellent surgical anesthesia but have limited duration of action. Therefore, different adjuvants (eg. opioids, clonidine, atracurium, dexmedetomidine, dexamethasone, magnesium sulphate) are combined with local anesthetic drugs to accelerate the onset and prolong the duration of action.⁶⁻¹¹ Effect of dexamethasone when mixed with LA has prolonged the duration of action, which is demonstrated in spinal anesthesia, epidural anesthesia and brachial plexus block.¹²⁻¹⁴ In addition, perineural dexamethasone prolongs the duration of postoperative analgesia and reduces requirement of oral and parenteral analgesics.¹⁵

Limited studies have explored the technique of adding dexamethasone in ophthalmic blocks and its results on post-operative pain and morbidity.^{10,16} Therefore, the current study was designed to assess the efficacy of two different doses of dexamethasone in peribulbar block in adult patients undergoing small incision cataract surgeries (SICS).

METHOD

This prospective, longitudinal study on 120 patients posted for SICS was conducted in a tertiary eye hospital, southern India, Karnataka, performing outreach camps to diagnose and treat conditions causing preventable blindness mainly cataract. The methodology was reviewed and approved by institutional review board (date: 22nd August 2018) and adhered to all the principles mentioned in the declaration of Helsinki 2000. The sample size was calculated based on similar research by Mahmoud et.al where dexamethasone and peribulbar anaesthesia was used.¹⁰ We arrived at the following calculation using statistical formula.

- $$n = 2 \frac{(Z\alpha + Z1-\beta)^2 \sigma^2}{\Delta^2}$$
- $Z\alpha$ = constant based on α error and sides of the study. For our 2-sided study & α error as 5%, $Z\alpha$ is 1.96
- $Z1-\beta$ = constant based on power of the study. For power 80%, $Z1-\beta$ is 0.8416
- σ = standard deviation obtained in the review of literature
- Δ = difference in intervention (mean difference)
- From the Mahmoud et.al study $\sigma = 13.42$ & $\Delta = 158.26 - 148.52 = 9.74$
- Now
$$n = 2 \frac{(1.96 + 0.8416)^2 13.42^2}{9.74^2} = 29.8$$
- Assuming a drop-out rate of 25%
$$na = \frac{n}{(1-25\%)} = \frac{29.8}{0.75} = 39.73 \approx 40$$
- 40 per group x 3 groups = 120 patients

Patients aged between 40-85 years, of either sex with American Society of Anaesthesiologists (ASA) physical status I-II and scheduled for SICS under peribulbar block were included in the study whereas patients who refused to be enrolled, morbidly obese patients, patients with excessive tremors or agitations, history of anticoagulant therapy, allergic to LA, bilateral cataract, axial length <20 mm and >24 mm and patients with glaucoma were excluded. Preoperative assessments and details of the anesthetic technique were explained to the patients at the preoperative visit. Informed written consent was taken from all patients. The study patients were assigned to three groups as follows:

Group LAO: Local anesthetic only (LAO) consisted of a mixture of 7 ml of 2% lignocaine with (1 in 100000) adrenaline and hyaluronidase (30 IU/ml) + 1 ml of normal saline. Group LAD2: Local anesthetic with dexamethasone 2 mg (LAD2) consisted of a mixture of 7 ml of 2% lignocaine with 1 in 100000 adrenaline and hyaluronidase (30 IU/ml) + 0.5 ml normal saline and 2 mg dexamethasone (0.5cc).

Group LAD4: Local anesthetic with dexamethasone 4 mg (LAD4) consisted of a mixture of 7 ml of 2% lignocaine with 1 in 100000

adrenaline and hyaluronidase (30 IU/ml) + 4 mg dexamethasone (1cc).

40 chits of each group were given to trained operation theatre assistant (OTA) who prepared the drugs in 10ml syringes and handed over to ophthalmologist who is supposed to give the peribulbar block. All blocks were given by the same ophthalmologist who was blinded to the study group. Inferotemporal peribulbar block was administered with 25gauge needle and 5 ml of the prepared LA was injected after negative aspiration. Block was then supplemented with medial canthus peribulbar block where another 3ml of LA was injected.

The investigator who recorded the readings at defined time intervals was unaware about the group allocation. The onset and duration of globe akinesia, and lid akinesia were recorded. Onset of corneal anesthesia was not checked as per the hospital protocol of avoiding any contact procedure 24 hours prior to cataract surgery. Intraoperative and postoperative patient comfort - visual analogues scores (VAS), postoperative analgesic request, and recorded complications due to drugs used were assessed.

Assessment of block:

(A) Motor:

- Lid akinesia was defined based on lid movements during attempted eye opening after block. It was classified as: 0 - complete akinesia, 1 - partial movement in either or both eyelid margins, 2 - normal movement in either or both eyelid margins. The time of onset of lid akinesia was defined as the time elapsing from the injection of LA solution till complete lid akinesia.
- Ocular motility/ globe akinesia was assessed by scoring the ocular movements in each direction of gaze (superior, inferior, medial and lateral) using three-point scale. Scoring is done in each direction based on the position of limbus/pupil on attempted movement: 0 - no movement, 1 - limited, 2 - normal.

The time of onset of globe akinesia was defined as time elapsed from the time of injection of LA to complete globe akinesia(score=0). Duration of lid akinesia was recorded, from time of injection of anesthetic mixture till full recurrence of lid movement. The duration of globe akinesia was recorded from the time of injection of LA mixture till recurrence of muscle movement (score 8). Non-invasive blood pressure, heart rate and oxygen saturation were checked at regular intervals during the entire procedure and post-operatively. Time of adequate condition to begin surgery was defined as ocular movement score ≤ 1 in each direction and an eyelid akinesia score of 0. In patients with incomplete block after 15 min from injection, supplementary anesthesia were provided with a further injection of 2% lignocaine and the patients were excluded from study.

(B) Assessment of pain: Postoperative pain was assessed using VAS. Pain assessment was done at the end of surgery and then every 2nd hourly for up to ten hours after surgery. Oral paracetamol was given on analgesic request by the patient or when VAS score was >5 as rescue analgesia. Total analgesic consumption in each group were analysed.

Postoperative nausea and vomiting were managed with ondansetron 4 mg intravenously. Intraocular pressures were measured in patients who had excessive pain after rescue analgesia and treated accordingly if found high.

Statistical Analysis

All Quantitative variables were checked for normal distribution within each category of explanatory variable by using visual inspection of histograms and normality Q-Q plots. Shapiro-wilk test was also conducted to assess normal distribution. Shapiro-wilk test p value of >0.05 was considered as normal distribution.

Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. Non-normally distributed quantitative variables were summarized by median and interquartile range (IQR). Data was also represented using appropriate diagrams like bar diagram, pie diagram and box plots.

For normally distributed Quantitative parameters the mean values were compared between study groups using ANOVA (3 groups). For non-normally distributed Quantitative parameters, Medians and Inter Quartile Range (IQR) were compared between study groups using Kruskal Wallis test. The change in the quantitative parameters, before

and after the intervention was assessed by paired t-test (In case of two time periods) or one-way repeated measures ANOVA (In case of comparison across more than 2 time periods).

If statistically significant difference was found in ANOVA, appropriate post -hoc test (LSD/ Bonferroni) was used to assess statistical significance of pair wise comparisons.

Categorical outcomes were compared between study groups using Chi square test /Fisher's Exact test (If the overall sample size was <20 or if the expected number in any one of the cells is <5 , Fisher's exact test was used.)

P value < 0.05 was considered statistically significant. IBM SPSS version 22 was used for statistical analysis.

RESULTS

A total of 118 patients from three groups were analysed. LAO group had 38 patients (32.20%), LAD2 had 40 patients (33.90%) and LAD4 had 40 patients (33.90%). Two patients from LAO group were excluded as they required repeat injection to supplement the block. Overall, demographic parameters and mean axial length were comparable across groups (Table 1).

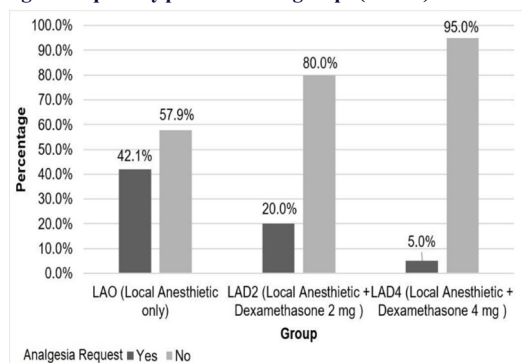
Table1: Comparison of demographic parameters and mean axial length (mm) across the study groups (N=118)

Parameter	LAO (N = 38)	LAD2 (N = 40)	LAD4 (N = 40)	P value (Kruskal - Wallis test)
Age [Median (IQR)]	63.50 (51.50, 68.00)	65.00 (60.00, 68.00)	62.00 (58.00, 66.50)	0.623
Gender				
Male	17 (44.73%)	15 (37.5%)	15 (37.5%)	0.755
Female	21 (55.26%)	25 (62.5%)	25 (62.5%)	
Eye				
Right	23 (60.52%)	18 (45%)	20 (50%)	0.377
Left	15 (39.47%)	22 (55%)	20 (50%)	
Axial Length(mm) Mean $\pm$ SD	22.79 $\pm$ 0.65	22.59 $\pm$ 0.83	22.80 $\pm$ 0.72	0.229 (LAD2 Group) 0.952 (LAD4 Group)

N – Number, LAO - Local Anesthetic only, LAD2 - Local Anesthetic + Dexamethasone 2 mg, LAD4 - Local Anesthetic + Dexamethasone 4 mg, SD – Standard deviation, IQR – Interquartile range. mm-millimetre.

The median (IQR) of operation duration was 20.00 (20.00, 20.00) minutes in LAO group and it was same in group LAD2 and LAD4 as LAO (P value >0.05). The median difference of Lid akinesia duration across study groups was also not statistically significant (P value >0.05).

Graph 1: Clustered bar chart for comparison of postoperative Analgesia request by patient across groups (N=118)

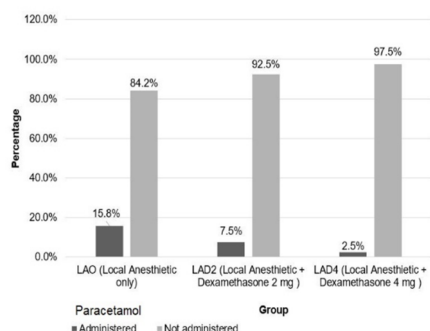


The median (IQR) of Globe akinesia onset was 8.00 (6.00, 10.00) in LAO group and it was 6.00 (4.00, 6.00) in group LAD2 and 4.00 (2.00, 4.00) in LAD4. The median difference of Lid akinesia and Globe akinesia onset across study groups was statistically significant (P value <0.001). (Table 2).

Table 2: Comparison of median of different onset of time and different durations across the study groups (N=118)

Parameter	LAO (Median (IQR))	LAD2 (Median (IQR))	LAD4 (Median (IQR))	P value (Kruskal - Wallis test)
Operation Duration (Min)	20.00 (20.00, 20.00)	20.00 (20.00, 20.00)	20.00 (20.00, 20.00)	0.804
Lid Akinesia Onset (Min)	4.00 (2.00, 6.00)	2.00 (2.00, 4.00)	2.00 (2.00, 2.00)	<0.001
Globe Akinesia Onset (Min)	8.00 (6.00, 10.00)	6.00 (4.00, 6.00)	4.00 (2.00, 4.00)	<0.001
Lid Akinesia Duration (Hrs)	4.00 (3.50, 4.00)	4.00 (4.00, 6.00)	4.00 (4.00, 6.00)	0.005
Globe Akinesia Duration (Hrs)	4.00 (2.00, 4.00)	4.00 (4.00, 6.00)	6.00 (4.00, 8.00)	<0.001

LAO - Local Anesthetic only, LAD2 - Local Anesthetic + Dexamethasone 2 mg, LAD4 - Local Anesthetic + Dexamethasone 4 mg, IQR – Interquartile range, Hrs – Hours, Min – Minutes

Graph 2: Clustered bar chart for comparison of paracetamol administered for patients with VAS>5 across groups (N=118)

The proportion of patients who requested analgesia was 16 (42.10%) in LAO group, 8 (20%) in LAD2 and 2 (5%) in LAD4 (Figure 1). The difference in the proportion of analgesia requested patients across study groups was statistically significant (P value<0.001) (Table 3). The difference in the median VAS scores in VAS2, VAS6 and VAS8 across study groups was statistically significant (P value<0.05).

Table 3: Comparison of median of different pain scores and analgesia request by patient across the study groups (N=118)

Parameter	LAO [Median (IQR)]	LAD2 [Median (IQR)]	LAD4 [Median (IQR)]	P value (Kruskal - Wallis test)
VAS2	1.00 (0.00, 2.25)	0.00 (0.00, 2.00)	0.00 (0.00, 1.00)	0.031
VAS4	2.50 (0.00, 4.00)	2.00 (1.00, 3.00)	2.00 (1.00, 2.00)	0.09
VAS6	0.00 (0.00, 0.00)	0.00 (0.00, 2.00)	1.00 (0.00, 2.00)	0.001
VAS8	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.00 (0.00, 2.00)	<0.001
VAS10	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.377
Analgesia request				
Yes (n, %)	16 (42.10%)	8 (20%)	2 (5%)	<0.001
No (n, %)	22 (57.89%)	32 (80%)	38 (95%)	<0.001

– number, LAO - Local Anesthetic only, LAD2 - Local Anesthetic + Dexamethasone 2 mg, LAD4 - Local Anesthetic + Dexamethasone 4 mg, IQR – Interquartile range, mg - milligram

Comparison of median of different pain scores and analgesia request by patient across the study groups is shown in table 3 and clustered bar chart for the same is shown in figure 1.

None of the patients complained of nausea or vomiting or had features suggestive of intraocular pressure or infection during postoperative period. Vital hemodynamic parameters were stable during the perioperative period in all patients. Comparison of paracetamol administered for patients with VAS > 5 across groups is shown in table 4 and clustered bar chart for the same is shown in Graph 2.

Table 4: Comparison of paracetamol administered for patients with VAS>5 across groups (N=118)

Paracetamol Administered for patients with VAS >5	Group			Chi square	P- value
	LAO	LAD2	LAD4		
Administered (n, %)	6 (15.78%)	3 (7.5%)	1 (2.5%)	4.511	0.105
Not administered (n, %)	32 (84.21%)	37 (92.5%)	39 (97.5%)		

– number, LAO - Local Anesthetic only, LAD2 - Local Anesthetic + Dexamethasone 2 mg, LAD4 - Local Anesthetic + Dexamethasone 4 mg, VAS – Visual Analogous Score. mg – milligram

DISCUSSION

The recent advances in cataract techniques have focused on quality of care over quantity and post-operative morbidity related issues; this was possible through recent advances in anesthesia techniques – general to local anesthesia. Local anesthesia with adjuvants has shown results and the current study demonstrated the use of dexamethasone. Dexamethasone is a long acting glucocorticoid with potent anti-inflammatory and immunosuppressive action. Dexamethasone is widely used in ophthalmic practice also. Proposed mechanisms of analgesia are local action on nerve fibers blocking transmission of nociceptive C-fibers suppressing ectopic neural discharge, vasoconstrictive action, systemic anti-inflammatory effect.¹⁷⁻¹⁹ Topical, sub-conjunctival, intra-vitreous and systemic dexamethasone is given in various ophthalmic conditions. Intraocular injection of dexamethasone has been given for treatment of uveitis.

After thorough literature search and to the best of authors' knowledge, this is probably the first study which has compared the effect of two different doses of dexamethasone in peribulbar anesthesia till date. In this study, we found that the addition of dexamethasone to 2% lignocaine with adrenaline hastens the onset of lid akinesia and globe akinesia, prolongs the duration of globe akinesia and reduces the requirement of postoperative analgesia without significant side effects. Similar study by Mahmoud et al describes the effect of dexamethasone as an adjuvant to local anesthetic in peribulbar block but in posterior segment ocular surgeries.¹⁰ Patients who received 4mg dexamethasone as adjuvant had fewer rescue analgesia requirements. Along with prolonged analgesia, patients also had reduced postoperative nausea and vomiting and postoperative inflammatory response. However, the onset of lid and globe akinesia were not significant compared to control group. In our study, although addition of 2 mg and 4 mg dexamethasone was effective in hastening the onset of lid and globe akinesia, effect of 4 mg dexamethasone was more pronounced in prolonging the duration of globe akinesia and reducing the postoperative analgesic requirements. Effect of different doses of dexamethasone (1 to 10 mg) has been studied in brachial plexus blocks.²⁰ Arafa S. K. in their study reported that addition of dexamethasone in peribulbar block prolonged duration of anesthesia, duration of akinesia, delayed pain perception, reduced analgesic requirements but delayed onset of lid and globe akinesia. Ashraf and team compared dexamethasone and dexmedetomidine as adjuvants in peribulbar block and concluded that addition of dexamethasone and dexmedetomidine to bupivacaine and lidocaine local anesthetic mixture in peribulbar block for vitreoretinal surgeries provided safe and effective block with prolonged duration and decreased requirements of postoperative analgesia.²¹

Cataract surgeries conducted in camp approaches in low-middle income countries are known for its poor quality of services.²² However, with the proposed technique the post-operative morbidity will be reduced and also improve the quality of care. In addition, would also reduce the cost of care in terms of direct/in-direct cost incurred by patients and family members as a result of less-number of hospital days stay & or visits.

The effect of adjuvants during the surgical procedure was well appreciated by the operating surgeon considered in the study. However, the study had few limitations: the onset of corneal anesthesia was not recorded due to mandatory adherence to hospital protocol of “no contact” for 24 hours prior to cataract surgery. Hence, we could not study the effect of dexamethasone on the onset of corneal anesthesia. We did not measure the blood sugar levels post operatively.

CONCLUSION

Addition of dexamethasone as an adjuvant to lignocaine provides safe and effective anesthesia in patients undergoing small incision cataract surgery. Dexamethasone hastens the onset of lid and globe akinesia, prolongs duration of globe akinesia and reduces postoperative analgesic requirements. Dexamethasone 4 mg is more effective compared to 2 mg in hastening the onset and prolonging the duration of globe akinesia and providing effective analgesia. These benefits are especially important in ophthalmic centers performing high volume of ophthalmic surgeries. Additionally, this gave ample time for surgeon to complete surgery with ease. This technique would revolutionize the process of reducing cataract blindness, in high-volume, low-income settings and contribute to overall socio-economic gain in the community.

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Author Contribution:

Shwetha, Sandhya and Ravindra conceptualized the study. Shwetha, Abhishek and Kavitha designed the study methodology. Shwetha and Abhishek collected and analysed the data. Shwetha, Sandhya, Kavitha, and Ravindra reviewed the analysis of data. Shwetha took lead in drafting the manuscript with Abhishek and Kavitha. All authors read and approved the manuscript.

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