

## Oculocardiac reflex in phacoemulsification: Peribulbar vs topical anesthesia

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**Purpose:** This study compares the vital parameters and pain experienced during phacoemulsification under peribulbar and topical anesthesia to determine the incidence of OCR. **Methods:** One hundred six patients are enrolled for phacoemulsification in a prospective and randomized study. Fifty-two patients undergo surgery in a peribulbar block (Group PB) and 54 in topical anesthesia (Group TA). Mean arterial pressure (MAP) and pulse rate are recorded during a preoperative check-up and at four other steps of surgery. Pain experienced during surgery and on a postoperative day, 5, is graded with a verbal analogue scale. OCR defined as a decrease in pulse rate by greater than 20% is calculated. Chi-square test, Fisher's exact test, paired *t* test and the comparison of means give the statistical analysis. A value of  $P < 0.05$  was taken as significant. **Results:** MAP readings at baseline versus MAP at other steps of surgery show a trend towards rising with a  $P$  value of  $< 0.05$  in both groups. Pulse rate measured at all steps of surgery versus baseline pulse rate in Group TA shows  $P < 0.05$ . OCR is present in nine patients in peribulbar block versus eleven patients in topical anesthesia with  $P$  value of 0.687. The pain scores using verbal analogue scale were higher in Group TA compared with Group PB with a  $P < 0.0001$ . **Conclusion:** Oculocardiac reflex can occur during phacoemulsification under both peribulbar block and topical anesthesia, and the difference is not significant.

**Key words:** Mean arterial pressure, oculocardiac reflex, peribulbar, topical

Oculocardiac reflex (OCR) is a cardiac manifestation occurring due to the physical stimulation of the eye. Aschner and Dagnini first described it in 1908 as a reflex resulting in bradycardia most commonly caused by traction on the extraocular muscles, pressure on the globe, ocular trauma, traction on the conjunctiva, and retrobulbar anesthesia.<sup>[1]</sup> OCR is defined as a decrease in pulse rate by greater than 20%.<sup>[2]</sup> It is less common during phacoemulsification as compared to other eye surgeries involving the extraocular muscles. Eye surgeons use different types of anesthesia for phacoemulsification of which peribulbar and topical anesthesia are the most routinely used.<sup>[3]</sup>

Peribulbar anesthesia, first described by Davis and Mandel in 1986, is the most commonly used anesthesia for cataract surgery. However, complications such as incomplete anesthesia, globe perforation, peribulbar hemorrhage, and increase in intra-ocular/intra-orbital pressures are known.<sup>[4]</sup> In 1993, Kershner published a report on topical anesthesia. Many cataract surgeons prefer it due to its speed and ease of administration entirely avoiding the block related complications and shortening the post-operative recovery time.<sup>[5]</sup> Ophthalmologists primarily operating cataract as a daycare procedure should be well acquainted with the incidence and sequelae of OCR. Many studies are comparing either the intraoperative pain or the vital signs in phacoemulsification under different types of anesthesia. Studies commenting on both the aspects and also giving an incidence of OCR are

less in number. This study compares the incidence of OCR between patients undergoing phacoemulsification by topical and peribulbar anesthesia by studying the difference in the vital parameters and pain experienced by patients during the procedure.

### Methods

One hundred and six patients are enrolled for phacoemulsification in this prospective study. Patients are randomly distributed in two groups based on their OPD consultation numbers (even and odd). The patients with even numbers are sorted for phacoemulsification under topical anesthesia (Group TA) and with odd numbers in peribulbar block (Group PB). The inclusion criteria of the study was cataract with nuclear sclerosis grade II or III with uneventful phacoemulsification. The exclusion criteria of the study were deep orbital sockets, non-dilating pupil, mature cataracts, complicated cataracts, patients with hearing loss, any cardiac abnormality, and partial peribulbar block.

After finding fit for surgery with normal routine preoperative investigations and pre-anesthetic checkup, written and informed consent for phacoemulsification was taken. Phacoemulsification is done with a 2.8 mm temporal

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corneal incision with 54 patients enrolled in the Group TA and 52 in the Group PB. Topical anesthesia was administered in the conjunctival cul de sac of the eye under surgery. Eyedrop proparacaine 0.5% one drop each was instilled in the immediate preoperative period and 5–6 times during surgery in topical anesthesia.<sup>[6]</sup> Peribulbar block is prepared with a combination of injection Lignocaine 2% + injection Bupivacaine 0.5% and was administered with a 23-gauge needle in the amount of 3–5 mL, at the lateral 1/3 and medial 2/3 junction of the lower orbital rim in between the eyeball and the orbital bone.<sup>[7]</sup>

Steps of surgery are similar for each case and duration of surgery is noted for each case. Blood pressure and pulse readings are recorded during the preoperative check-up and four different steps: 1. Block, 2. Incision, 3. Phacoemulsification and 4. Lens insertion. A multiparameter monitor (UNI-EM Multiscope 3) is used to measure the vitals of the patient. The blood pressure measured is converted to mean arterial pressure (MAP) which can be approximately estimated using a formula. For calculating the mean arterial pressure, the diastolic blood pressure is doubled and added to the systolic blood pressure, and that composite sum is then divided by three. Normal MAP ranging between 65 and 110 mm Hg is used for comparison.<sup>[8]</sup> The mean arterial blood pressure and the pulse rate during preoperative check-up are considered as the baseline parameters to compare with the mean arterial pressure and pulse rate taken at each of the four steps of surgery. OCR defined as a decrease in pulse rate by greater than 20% is calculated accordingly.<sup>[2]</sup> Pain experienced during surgery is graded with a verbal analogue scale as; Grade 0: No pain, Grade 1: Mild pain, Grade 2: Moderate pain, Grade 3: Severe pain.<sup>[9]</sup>

All the data were stored in a Microsoft Excel spreadsheet. The data were analyzed using IBM SPSS Statistics version 20.0 (IBM, Armonk, New York). *P* value with relation to baseline characteristics and incidence of OCR was calculated by comparison of means and Chi-square test, whereas the comparison of MAP and pulse rate during preoperative check-up versus that measured during other steps of surgery by Student's paired *t* test. We compared the pain parameters in the two groups with the comparison of means and standard deviation. A value of *P* < 0.05 was considered statistically significant.

## Results

### Baseline characteristics

In the peribulbar block, 20 male patients and 32 female patients are operated. In topical anesthesia, 27 males and twenty-seven females are operated. The mean age of the patient measured in years in Group PB is  $66.52 \pm 7.68$ , and in Group TA is  $64.34 \pm 5.55$ . Preoperative baseline pulse rate measured in Group PB is  $77.51 \pm 8.90$  per minute is and the baseline pulse rate in Group TA is  $76.85 \pm 8.74$  per minute. Mean duration of surgery in Group PB is  $19.13 \pm 7.93$  minutes and Group TA is  $17.39 \pm 5.90$  minutes. No statistically significant difference was observed in the baseline characteristics such as gender, age, preoperative pulse rate and duration of surgery between patients in both groups [Fig. 1].

### Oculocardiac reflex (OCR)

OCR, as defined by a decrease in pulse rate of greater than 20%, is noted. Nine of 52 (17.3%) patients in Group PB and 11 of 54 (20.3%) patients in Group TA were found to have OCR

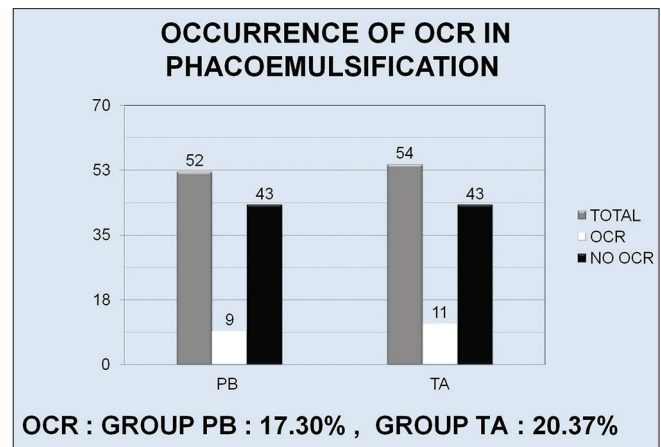


Figure 1: Occurrence of oculocardiac reflex in phacoemulsification

during Phacoemulsification [Fig. 1]. The Chi-square statistic was 0.1623. The *P* value was 0.687028, not significant at *P* < 0.05. The Chi-square statistic with Yates correction was 0.0239. The *P* value was 0.877138, not significant at *P* < 0.05.

### Mean arterial pressure (MAP)

The MAP readings at each surgical step was compared to the baseline MAP of the patients with OCR in both groups, by Student's paired *t* test, and it was significantly higher at each step [Table 1]. Similarly, the patient's pulse at each surgical step was compared to the baseline pulse (measured during preoperative checkup) of the patients with OCR by Student's paired *t* test, and was significantly lower at each step in both the groups [Table 1]. The Pearson's correlation coefficient between the MAP and the pulse at various corresponding steps of surgery in patients with OCR was -0.11.

### Pulse rate

In our study, comparing the data of pulse rates in the 20 patients with OCR, the minimum pulse rate reached was 48 per minute that is the maximum decrease in pulse rate was 36.8% (found in three patients). The pulse rate below the level of 60 per minute is found in six patients. None of the OCR patients is below the critical level of OCR, that is, pulse rate of less than 40/minute.<sup>[10]</sup> All OCR patients in our study were found to be asymptomatic, maintaining the MAP and none of them received injection Atropine. Two patients of 20 (10%) OCR patients showed a rise in the MAP above the normal range, both of them were from Group TA. OCR in patients with high MAP was compared with OCR in patients with normal MAP with Fisher exact test and was not significant (*P* = 0.4789).

Intergroup comparison between MAP and pulse rates at the corresponding surgical steps in all patients is statistically not significant [Table 2].

### Intraoperative pain

The pain scores using verbal analogue scale were higher in Group TA compared with Group PB with a *P* < 0.0001.

## Discussion

The nerve connections between the Ophthalmic division of the fifth (Trigeminal) cranial nerve (afferent) and the tenth (Vagus) cranial nerve (efferent) cause the Oculocardiac reflex. These trigeminal nerve synapse with the visceral motor nucleus of

the Vagus nerve, in the brain stem. The efferent nerve carries the impulse from the cardiovascular center in the brain stem to the heart, leading to decreased output from the Sinoatrial node. This reflex is known to occur at all ages but is more common in children and strabismus surgeries.<sup>[1]</sup> The other mechanism, that is, abnormal rise in blood pressure can also lead to bradycardia, in response to the stimulation of baroreceptors in the Carotid sinus. The sense of rising in blood pressure reaches the cardiovascular centers in the brain stem and activates the Vagus nerve, and neurons release acetylcholine at the synapses with cardiac muscle cells.<sup>[11]</sup>

The report of high blood pressures in patients waiting for a surgical procedure is not surprising.<sup>[12,13]</sup> Suzuki *et al.* and Katalin Gombos *et al.* studied the vital signs of patients in phacoemulsification. Both the studies found that there is a significant increase in the systolic and diastolic blood pressure between baseline and the blood pressure measured at various

steps of surgery in both types of anesthesia.<sup>[13,14]</sup> In our study, all patients who underwent phacoemulsification, the MAP measured at all steps shows a significant rise as compared to the baseline MAP even though the blood pressure at baseline is normal with or without antihypertensives, which is consistent with the studies by Suzuki *et al.* and Katalin Gombos *et al* [Tables 3 and 4].

Aytekin Apil *et al.* shows that the Eyedrop 0.5% Proparacaine does not entirely abolish the pain during phacoemulsification.<sup>[15]</sup> The patients in this study are found to have either no pain or mild to moderate pain during surgery. The pain scores using verbal analogue scale are higher in Group TA compared with Group PB, which shows topical anesthesia (Proparacaine eye-drop) does not entirely abolish the pain, which is similar to the finding of Aytekin Apil *et al.* study. The patients in Group PB though complained of pain during (needle block) anesthesia are more comfortable during surgery.

**Table 1: Baseline mean map and mean pulse rate compared to each step in OCR patients**

	Mean MAP	SD	P Significantly Increasing	Mean PULSE RATE	SD	P Significantly Decreasing
PREOP	90.93	8.90		81.60	7.13	
STEP 1	98.13	11.36	0.00*	65.70	8.70	0.00*
STEP 2	97.52	11.53	0.02*	60.55	7.78	0.00*
STEP 3	98.08	11.23	0.00*	60.90	7.60	0.00*
STEP 4	96.53	11.36	0.02*	63.00	8.65	0.00*

Students' paired t test. \*Standard deviation (SD)

**Table 2: Intergroup comparison of map and pulse rate**

	P (MAP) All patients	P (MAP) OCR patients	P (Pulse rate) All patients	P (Pulse rate) OCR patients
PREOP	0.23*	0.88*	0.70*	0.66*
STEP 1	0.65*	0.48*	0.43*	0.72*
STEP 2	0.96*	0.44*	0.44*	0.44*
STEP 3	0.66*	0.69*	0.09*	0.37*
STEP 4	0.79*	0.54*	0.09*	0.06*

Students' paired t test\*

**Table 3: Baseline mean map and mean pulse rate compared to each step in group PB**

	Mean MAP	SD	P Significantly Increasing	Mean PULSE RATE	SD	P Significantly Decreasing
PREOP	95.11	11.64		77.52	8.90	
STEP 1	99.97	10.39	0.00*	75.46	12.16	0.15*
STEP 2	100.05	9.62	0.00*	74.04	12.29	0.02*
STEP 3	98.84	10.20	0.01*	74.67	12.28	0.06*
STEP 4	98.88	10.31	0.00*	75.02	12.07	0.07*

Students' paired t test\*

**Table 4: Baseline mean map and mean pulse rate compared to each step in group TA**

	Mean MAP	SD	P Significantly Increasing	Mean PULSE RATE	SD	P Significantly Decreasing
PREOP	92.51	10.41		76.85	8.74	
STEP 1	99.06	10.61	0.00*	73.65	11.19	0.02*
STEP 2	100.26	10.23	0.00*	72.24	11.73	0.00*
STEP 3	99.72	10.52	0.00*	70.81	10.98	0.00*
STEP 4	99.41	10.46	0.00*	71.19	11.08	0.00*

Students' paired t test \*

The baseline pulse rate versus pulse rate during temporal corneal incision (STEP 2) in Group PB is significantly decreased but, greater than 20% decrease was found only in 17.3% patients [Table 3]. The above comparison infers that temporal corneal incision (mechanical stimulation) made under a peribulbar block, does pass the stimulus to Tenth cranial nerve Vagus. Baseline pulse rate versus pulse rate measured during all four steps in Group TA is significantly lower in all steps of surgery, but higher than 20% decrease was in 20.3% patients, which can be related to incomplete abolition of pain, one of the factors for triggering OCR.<sup>[16]</sup> [Table 4] Apt L *et al.* shows that the incidence of OCR associated with mechanical stimulation of the eye varies from 16 to 80% and the incidence is on a higher side for strabismus surgeries.<sup>[17]</sup> Montero *et al.* used 0.5% tetracaine eye drops and found that the incidence of phacoemulsification is 22.3% in his study.<sup>[16]</sup> In our study, 17.3% of patients had OCR in a peribulbar block and 20.3% in topical anesthesia which is consistent with the findings by Apt L *et al.* and Montero *et al.*

## Conclusion

OCR can occur during phacoemulsification under both peribulbar & topical anesthesia, and the difference is not significant. It shows that even with a noninvasive anesthesia technique, the risk of Oculocardiac reflex remains the same. Therefore, one should be extremely careful, especially when performing surgery in outpatient settings. In every case of phacoemulsification, intravenous access, availability of emergency drugs and availability of anesthetist is mandatory.

## Ethical approval

The procedure performed in this study involving human participants is following the ethical standards of the institutional/national research committee, the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

## Consent

We have obtained written, informed consent from all the individual participants included in this study.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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