

# Oculocardiac Reflex And It's Relation With The Extraocular Muscles During Strabismus Surgery- A Prospective Study.

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## Abstract

Background: Oculocardiac Reflex (OCR) is a trigeminal reflex observed clinically by occurrence of bradycardia and cardiac dysrhythmia with the manipulations on the eye, more so after the traction on the extraocular muscles during ophthalmic surgery. Profound bradycardia during surgery is a serious event and so needs careful monitoring and timely intervention.

## Aim

Our study is aimed to monitor the incidence of OCR and its relationship with the each of the extraocular muscles during strabismus surgery under general anaesthesia

## Materials and Methods

Patients between the age group 1-25 years were enrolled after having detailed history and pre-anaesthetic check up with at least 6

hours of fasting. Standard anaesthesia technique was used for all the patients along with monitoring for SPO<sub>2</sub>, ECG, NIBP and ETCO<sub>2</sub>. During operation, the pre traction HR (baseline) and the HR change during traction (traction HR) were monitored in all these patients and the various extra ocular muscles involved were also noted. The OCR was considered positive when the drop in HR was more than 20%. PONV (postoperative nausea and vomiting) was also subsequently observed for the incidence in these patients.

## Results

Out of 122 patients considered for strabismus correction, 288 muscles were operated. Average age was 9.15±12.41 years. Females contributed to 53% of the total patients. OCR was more common under the age group of 15 years. The incidence of OCR was observed to be different in each extra ocular muscle, with an average of 24.75%. Medial rectus (23.51%), lateral rectus (16.10%), superior rectus (21.74%), inferior rectus (22.22%), superior oblique (28.57%) and inferior oblique (36.36%) are the extra ocular muscles that were studied for OCR in our study. PONV was observed in 21(17.2%) patients.

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## Conclusion

The overall incidence of OCR was 24.75%. The incidence was high in inferior and superior oblique muscles compared to other extraocular muscles. PONV was observed in 17.2 % of patients and had no relation to the OCR or multiple muscle surgery.

## Keywords

Strabismus surgery, extra ocular muscles, general anaesthesia, OCR, heart rate.

## Introduction

Strabismus is one of the common health problems among children and is being picked up by the health care workers under school health program.<sup>1</sup> Strabismus correction surgeries are among the common ophthalmic adjunct procedures that are required in children. Oculocardiac reflex (OCR) may manifest by sudden bradycardia, bigeminy, ectopic beats, nodal rhythm, AV block and cardiac arrest.<sup>2</sup> Exaggerated OCR may be imperil to the life of the patient. Various studies have concluded that general anaesthesia has higher incidence of OCR as compared with regional anaesthesia.<sup>(3)</sup> Strabismus correction surgery in paediatric patients anyway requires general anaesthesia and consequently aggravates the risk of OCR. Surgical procedure itself and anaesthetic drugs are among the various factors that precipitate OCR during strabismus surgery. Prophylactic measures are being used to minimise the OCR by modifying the anaesthetic drugs.

The incidence of OCR was most frequently observed when medial rectus was stimulated but the reflex response was different in different ocular muscles in other studies.<sup>(4,5)</sup> Various prophylactic measures are tried to curtail the OCR but with less success.<sup>6</sup> Very few studies are available to confirm which extraocular muscle has the high incidence of OCR.

Our study was aimed to observe the incidence of OCR and the response in different extraocular muscles in series of patients undergoing strabismus surgery under general anaesthesia.

## Materials and Methods

The present study was undertaken in our hospital after the approval (Ethics ref no. LEC 04-17-025) from the institute ethical committee (ECR/468/Inst./AP/2013). All patients planned for squint correction surgery of one or both the eyes of various extra ocular muscles between the age group 1-25 years were enrolled between the period of June 2017- May 2018. Detailed history and pre-anaesthetic check-up was done a day prior to surgery and all the patients were kept with minimum of 6 hours of fasting. Standard anaesthesia protocol was used in all the patients. In the operating room basic monitoring included- ECG, NIBP, SPO2 and ETCO2. Premedication was done with intravenous glycopyrrolate 4µg/kg, ondansetron (0.1mg/kg) and fentanyl (2µg/kg). After sufficient pre-oxygenation, anaesthesia induction was done with sevofurane or intravenous propofol (2mg/kg),

[depending upon the age of the patient]. Once adequate relaxation was achieved with intravenous atracurium (0.5mg/kg), trachea was intubated with appropriately sized RAE( Ring Adair Elwyn) tube and maintained on intermittent positive pressure ventilation with O<sub>2</sub>+N<sub>2</sub>O+sevoflurane and if required, with top up doses of atracurium. Paracetamol was used with intravenous dose of 15mg/kg for additional analgesia. All the operations were done by same experienced senior surgeon. Heart rate (HR) was recorded at base line (pre-traction) and at the time of traction (per- traction) in different muscles. Reduction in the HR of more than 20% was considered positive for OCR. Surgeons were asked to release the traction whenever the OCR occurred. Atropine (0.01mg/kg) was used intravenously only for persistent bradycardia (<60/min). All the patients were given with calculated volumes of fluids in the perioperative period. Towards the end of the surgery, muscle relaxation was reversed with glycopyrrolate (10µg/kg) and neostigmine (0.05mg/kg), extubated and shifted to the postoperative ward. In the post operative ward, the patients were monitored for vitals( heart rate, blood pressure, SpO<sub>2</sub> and respiratory rate) for 6 hours and any episodes of nausea and vomiting for till 24 hours.

The data were analysed using SPSS 20 and clinical values were compared and analysed using the Linear mixed model. Multivariate logistic regression was used to analyse the risk factors associated with the occurrence

of OCR. A p-value less than 0.05 was considered statistically significant.

### Observations

A total of 122 patients were enrolled for the strabismus surgery with the mean age group of 9.15 ±12.41 (range 1-25) years for single or multiple muscle correction. Female patients were 53% of the total patients and the remaining were male patients. Table 1 shows the Demographic data with the distribution of the ocular muscles that required surgery.

**Table 1: Demographic data distribution with the ocular muscle surgery**

OCCULAR MUSCLES	AGE	WEIGHT	SEX	
	MEAN & SD	MEAN & SD	M	F
MR	10.67±7.44	28.81 ± 17.22	51	48
LR	12.40 ± 7.23	35.09 ± 14.47	45	55
SR	12 .04 ±7.81	31.91 ± 16.64	61	39
IR	8.78 ±8.04	32.22 ±20.14	45	55
SO	12.01 ±8.98	32 ±1 6.98	43	57
IO	11.40 ± 7.04	31.30 ± 14.46	35	65

Among 122 patients, a total of 186 eyes with 288 various ocular muscles underwent corrective surgery. Figure 1 depicts the incidence of strabismus correction that was required in various ocular muscles. Frequency was high for lateral rectus and medial rectus followed by inferior oblique, superior rectus and superior oblique.

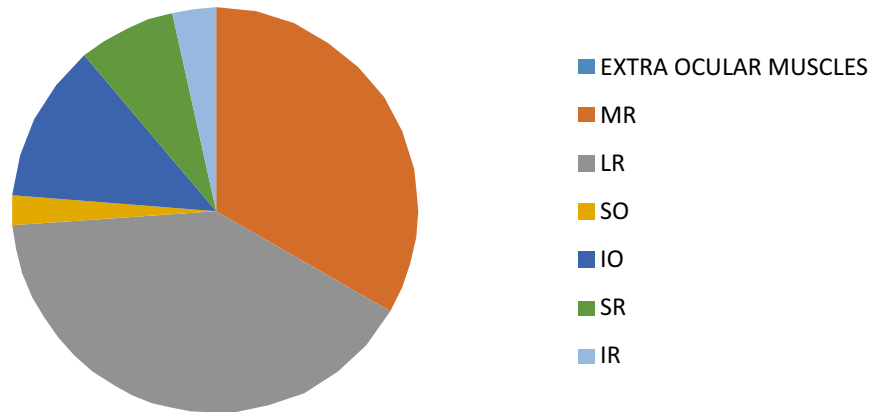


Fig. 1 represents the number of each extraocular muscle that were submitted for surgery.

Table 2 shows the heart rate variations with the traction on the extra-ocular muscle during strabismus surgery. Decrease in the heart rate was statistically significant when the muscle is pulled or on traction with all the above mentioned extra-ocular muscles but less with superior oblique muscle. Table 3 depicts the OCR with extraocular muscles and is calculated in the percentage form. In few cases, the bradycardia reverted back to normal by releasing the traction but only one patient required injection atropine to treat bradycardia.

Table 2: Change in the heart rate with traction on extraocular muscle.

OCULAR MUSCLES	PRE HR	Traction HR	95% Confidence interval		P Values
	MEAN & SD	MEAN & SD	LCL	UCL	
MR	106.27 ± 93.15	93.15 ± 25.24	10.06	16.17	0.0001
LR	98.56 ± 19.75	88.29 ± 23.13	8.25	12.3	0.0001
SR	101.00 ± 21.09	84.52 ± 24.30	12.02	20.94	0.0001
IR	110.89 ± 24.98	93.78 ± 27.34	6.33	27.89	0.0064
SO	91.00 ± 20.88	77.14 ± 21.47	4.51	23.2	0.011
IO	99.54 ± 21.24	82.03 ± 28.03	10.66	24.37	0.0001

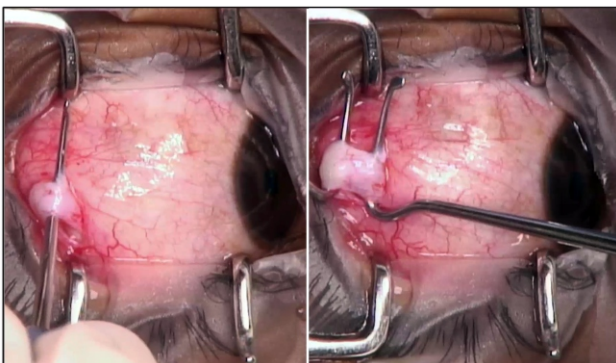
Table 3: Positive OCR and muscle association

EXTRA OCULAR MUSCLES	NO. OF EYES	POSITIVE OCR	PERCENTAGE
MEDIAL RECTUS	98	23	23.51%
LATERAL RECTUS	118	19	16.10%
SUPERIOR RECTUS	23	5	21.74%
INFERIOR RECTUS	9	2	22.22%
SUPERIOR OBLIQUE	7	2	28.57%
INFERIOR OBLIQUE	33	12	36.36%

Out of 122 patients, 21 patients were observed to have vomiting, amongst which 4 had undergone single muscle surgery and rest had multiple muscle corrective surgery. 115 patients had come for the first time for corrective surgery, rest 7 were for re-do correction surgery.

## Discussion

Strabismus is one of the common health problems among children.<sup>1</sup> Recently in view of cosmetic reasons also, the awareness has increased in the population for the need of corrective surgery. Different extraocular muscles are responsible for numerous forms of squinting of the eyes. Earlier the correction better is the result, so the younger age group patients are coming for corrective surgery. Strabismus surgery in paediatric patients always calls for general anaesthesia, see Figure 2. These patients are at high risk for the oculocardiac reflex (OCR) with prevalence of 14-90%. Exaggerated OCR may imperil the patient's life.<sup>2</sup> Some studies have concluded that the incidence of OCR is higher with general anaesthesia as compared to regional anaesthesia.<sup>3</sup> The incidence of OCR during strabismus surgery depends on various factors including the surgical procedure and usage of anaesthetic drugs.<sup>7</sup>



OCR is a trigeminovagal reflex which was first described by Arnold et al. The reflex begins with the activation of stretch receptors in the periorbital and ocular tissues. The impulses from the long and short ciliary nerves are carried to the ciliary ganglion where the ophthalmic division of the trigeminal nerve further transfer these impulses to Gasserian ganglion and subsequently to the trigeminal nucleus. The efferent circuit is from the visceral motor nucleus of the vagus nerve to the heart diminishing the SA node impulse with resultant bradycardia.<sup>7,8</sup> Clinically, bradycardia and cardiac rhythm disturbances subsequent to the manipulation on the eye.

Different anaesthesia regimen are used including BIS monitoring to minimise or prevent the OCR. No single regime is surely found to be effective.<sup>6</sup> Anti-cholinergics usage was also not of much help to prevent OCR.<sup>9,10</sup> Instillation of topical lignocaine to the eye muscle significantly attenuated the OCR.<sup>11</sup> Grover et al.<sup>3</sup> found that local anaesthesia produced less bradycardia and ectopic arrhythmia (14.4% as compared to 63.3%) and was better than general anaesthesia for surgeries in which traction of the extraocular muscle is required. Our study observed the incidence of OCR ranging from 16-36% for different muscles. The incidence of OCR in general anaesthesia cases was 20% in the study conducted by Subedhar et al.<sup>12</sup> whereas in another study the incidence was 85.5%.<sup>13</sup>

Few reports suggest OCR being more common in female patients where as our study and various other studies observed no significant difference between genders.<sup>13,14,15</sup>

A very few studies are available in the literature to confirm which extra ocular muscle has the high incidence of OCR with questionable results. In our study, the maximum occurrence of OCR was observed with inferior oblique muscle, followed by superior oblique, medial rectus, inferior rectus, superior rectus and least with lateral rectus. Superior rectus muscle has the stronger reflex and diabetics were found to have reflex insensitive.<sup>16</sup> Previous studies observed this with medial rectus as compared to other extra ocular muscles.<sup>17,18</sup> The study conducted by M Aletaha et al.<sup>13</sup> observed to have the higher incidence of OCR with cyclovertical muscles as compared to horizontal rectus muscles. The high incidence of OCR with cyclovertical muscle may be attributed to the difficulty in surgical exposure and the more pressure exerted during surgery. The above study results are in concurrence to our study results except for medial rectus. This discrepancy may be due the heterogenicity of the study population. They also concluded to have higher incidence of OCR for horizontal muscles if the baseline heart rate was more than 61/min. The present study results also showed more incidence of OCR in children less than 15 years as compared to the older patients. Ha et al.<sup>19</sup>

studied a total of 162 muscles with lateral rectus 122(76%), medial rectus 26(16%), superior rectus 2(1%) and inferior rectus 12(7%). The observations had no significant difference in the occurrence of OCR which is contradictory to results of our study.

Ohashi et al.<sup>14</sup> observed different depths, thresholds and incidence of reflex among various muscles. Bradycardia was not observed with stretching of the medial and inferior oblique with tensions less than 60g and 128 g, indicating lower threshold for inferior oblique and medial rectus. The study was done on three extra ocular muscles only. In our study, muscles responded differently with regards to OCR with less threshold to oblique muscles followed by medial rectus. With tractions of less than 100g on the lateral rectus evoked bradycardia that was significantly less than the other two muscles.<sup>14</sup> This observation is similar to our results showing less bradycardia with lateral rectus compared to other muscles. Tension for muscle traction was not used in our study to any of the muscles.

In our study, correction surgery was done up to six muscles in one or both the eyes. There was no relationship between the first muscle and the subsequent muscles for the risk of OCR. These observations co-relates with the study results of M. Aletaha et al.<sup>13</sup> but controversial results were observed by Machinda et al.<sup>15</sup> The incidence of OCR was high in the first than the subsequent muscle. Our results are in agreement with results of other study.<sup>19</sup>

PONV was observed in 21(17.2%) patients that had no relation to the OCR or multiple muscle surgery. The reason here may also be due to the use of antiemetic to all the patients. Our results were coinciding with the results of Subhedhar et al.<sup>12</sup> who observed no direct association between the PONV and positive OCR. However, some studies have indicated that PONV was more common in patients with positive OCR.<sup>20-25</sup> M Aletaha et al.<sup>13</sup> concluded in their study that OCR was three times higher in patients with PONV regardless of gender difference. Similarly few other studies also have observed OCR and vomiting in female patients under 15 years of age.<sup>22, 26-28.</sup>

### Conclusion

Our study shows a total Incidence of OCR at 24.75% with higher rate in inferior and superior oblique muscles. OCR was more common under the age group of 15 years. The relation between the development of OCR in the first muscle and subsequent muscles for strabismus muscle correction was not observed. Similarly, association of the PONV in patients with OCR was not found. Extreme vigilance, continuous monitoring and co-ordination with the operating surgeon are mandatory during strabismus correction surgeries to prevent catastrophic consequences of OCR.

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### Conflicts of interest

There are no conflicts of interest

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