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Research Article

Oculocardiac Reflex Incidence in Strabismus Surgery: A Cross Sectional Study

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Abstract

Background: To estimate incidence and surgical factors associated with the occurrence of oculocardiac reflex (OCR) during strabismus surgery.

Methods: After IEC approval, patients who underwent strabismus surgery under general anaesthesia were enrolled in this study. Heart rate was measured at baseline, when muscle is dissected, at maximum traction and when muscle is cut. Any change in heart rate from the baseline was observed. If there is > 20% reduction in heart rate then it was considered as oculocardiac reflex present. In patients with oculocardiac reflex present, number of muscles that were taken up for surgery and which muscle was being recessed or resected. Incidence of oculocardiac reflex was noted. Level of significance of association of surgical factors responsible and occurrence of OCR by chi square test was calculated.

Results: A total of 65 patients were enrolled and 90 muscles were operated. The incidence of OCR was 10.7% (7) in patients. Among muscles medial rectus operated were 65 and 25 Lateral rectus. OCR was observed only in 7 cases which were two muscle surgeries. OCR was seen in the first operated (medial rectus resection) muscle than in the second operated muscle. It was observed at traction of the muscle than on cutting. Age and two muscle surgery ($p < 0.05$ and $p < 0.05$) were significantly associated with occurrence of OCR. Medial rectus resection was highly associated with a greater occurrence of OCR however, they were not significantly correlated ($p = 0.09$).

Conclusion: Oculocardiac reflex prevalence in strabismus surgery was 10.7% in our set up. Age, patients with esotropia and two muscle surgery was a significant risk factor for OCR occurrence.

Keywords: *Anesthesia; Esotropia; Oculomotor Muscles; Oculocardiac; Reflex; Strabismus*

Introduction

Oculocardiac reflex is defined as a reduction in heart rate secondary to direct pressure placed on the eyeball [1]. It is defined by a decrease in heart rate by greater than 20% following globe pressure or traction of the extraocular muscles. The reflex most commonly results in sinus bradycardia. The incidence of the oculocardiac reflex is reported to be anywhere from 14% to 90% [2] and it is inversely associated with age, meaning pediatric patients are most at risk [3]. Pediatric patients are also more susceptible to the detrimental consequences of this reflex secondary to having a greater dependency on heart rate to maintain cardiac output [4]. Amongst the factors leading to wide range and severity of OCR occurrence maybe the effects of hypercarbia, hypoxia, acidosis, varied surgical pressure on eye [5] and the anesthetic agents used during surgery [6].

OCR has many detrimental effects including bradycardia, potentially fatal arrhythmias, asystole, and even cardiac arrest. Amongst non cardiac events, hypotensive episodes, syncope and gastrointestinal responses such as nausea and vomiting are associated with OCR [4,7].

So, it is important to prevent and treat the OCR and its potentially devastating consequences. The definitive treatment is the immediate cessation of the triggering stimulus [5]. It can be managed pharmacologically if the stimulus cannot be removed. Additionally, it is important to know what anesthetic agents can be used to help decrease OCR occurrence, as the incidence may vary with each agent used. Hence, we proposed a study to estimate the incidence and to study the factors responsible for OCR in our setting.

Objectives of the Study

- To estimate incidence of Oculocardiac reflex in patients of strabismus surgery.
- To explore the surgical factors responsible for oculocardiac reflex.

Methodology

After approval from IEC, a cross sectional observational study was carried out in patients undergoing squint surgery from September 2020 - June 2021. Written informed consent and in case of minors' assent of children along with written informed consent of parents was taken.

- Inclusion criteria: Squint patients, non-cardiac, non-hypertensive
- Exclusion: Cardiac and hypertensive patients.

The patients underwent preanesthetic checkup and all patients were kept NPO for 6 hours before surgery. In the operating room (OR) prevalidated monitoring devices including Electrocardiography (ECG), NIBP and pulse-oximetry (SpO_2) were attached. Premedication included injection glycopyrrolate 0.01 mg/kg I/V, injection ondansetron 0.1 mg/kg I/V and injection Butorphanol 0.02 mg/kg I/V. After preoxygenation for 3 minutes, Induction was done with 1.5 - 2 mg/kg I/V of Propofol and injection Atracurium 0.5 mg/kg I/V was given to facilitate endotracheal intubation. Patients was ventilated for 3 minutes. After these patients were intubated. Bilateral air entry will be checked and tube will be fixed. Anesthesia was maintained with 50% oxygen, 50% nitrous oxide, Isoflurane and injection Atracurium 0.1 mg/kg I/V as and when required. All the patients were given peribulbar block consisting of 6 ml Xylocaine and 4 ml Sensorcaine in the eye that underwent strabismus surgery. Heart rate was observed every 5 minutes.

After cleaning and draping the eye undergoing strabismus surgery, universal speculum was applied and two traction sutures with 3-0 nylon were applied at 12'o clock and 6 o' clock in the conjunctiva. After that conjunctival flap was formed and the muscle was dissected. The muscle was then secured with 6- 0 vicryl sutures and then resected or recessed according to patient's angle of deviation and to standardized values. Then the muscle was reinserted on sclera. Same procedure was followed for the other muscle if required. Conjunctiva was reattached with 6-0 vicryl and antiseptic dressing was done.

Demographic parameters were recorded. Heart rate was measured at baseline, when muscle is dissected, at maximum traction and when muscle is cut. Any change in heart rate from the baseline was observed. If there is $\geq$ 20% reduction in heart rate then it was considered as oculocardiac reflex present. In patients with oculocardiac reflex present, number of muscles that were taken up for surgery and which muscle was being recessed or resected. Incidence of oculocardiac reflex was noted. Level of significance of association of ocular factors responsible and occurrence of OCR by chi square test was calculated.

Results

A total of 65 patients (40 females and 25 males) with age ranging from 10 - 35 years (median 16.5 years) were enrolled for study. Out of 65 patients 45 (69.3%) patients had esotropia and 20 (30.7%) patients had exotropia. A total of 90 muscles were operated out of which Medial rectus was operated in65(45 resection and 20 recession) and 25 lateral rectus (18 resection and 7 recession).

During surgery, OCR occurred in 7(10.7%) patients. The range of age was 10-16 yrs. (median 12.5 yrs.) in patients with OCR, and 16 - 35 yrs. (median 20.5 yrs.) in patients without OCR. There were no significant differences in age and gender between patients with and without OCR. Demographics are presented in table 1.

Variable	Without OCR (n=58)		OCR (n=7)		p-value
Age (years)	Mean	SD	Mean	SD	<0.05
	20.5	9.2	12.5	7.6	
Gender					1.00
Male	22		3		
Female	36		4		
Diagnosis					<0.05
Esotropia	45		0		
Exotropia	13		7		

Table 1: *Demographic details of the patients undergoing strabismus surgery.*

Total number of muscles operated were 90 with a mean of 1.8 muscles per patient and OCR occurred in 7 patients with mean of 2 muscles operated per patient while OCR did not occur in 58 patients with mean of 1.3 muscles per patient. Baseline HR was in range of 90 - 130 beats/min (median 109/min), in OCR patients it was in range of 110 - 130 beats/min (median 120 beats/min) and in patients without OCR it was 90 - 125 beats/min (median 112 beats/min). It was higher in patients with OCR. Two muscle surgeries were done 25 patients and single muscle surgery in 40 patients. OCR was seen in 7 patients with two muscle surgery and 18 patients with two muscle surgery did not develop OCR. None of the patients with single muscle surgery had OCR. Regarding muscles, all the patients who developed OCR, it was observed while traction of medial rectus muscle undergoing resection and not seen while Later rectus muscle recession or resection or Medial rectus recession. Surgical details are presented in table 2. Relationship between heart rate at baseline, muscle dissection muscle traction and cutting of muscles in the patients with OCR and without OCR is presented in table 3.

Variable	Without OCR	With OCR	p- value
Number of muscles operated	1.3 +/- 0.9	2.0 +/- 1.1	0.53
Baseline heart rate	112.0 +/- 13.4 beats/ min	120.0 +/- 12.8 beats / min	0.31
Two muscle surgery	18	7	<0.05
Single muscle surgery	40	0	
Operated Muscles			
Medial rectus	58	7	0.09
Lateral rectus	18	7 (occurred during 2 muscle surgery when MR was resected)	NA
Surgery			
Medial rectus Resection	38	7	0.09
Medial rectus Recession	20	0	0.09
Lateral rectus resection	18	0	0.17
Lateral rectus recession	7	7 (occurred during 2 muscle surgery when MR was resected)	NA

Table 2: *Surgical details of the patients undergoing strabismus surgery.*

Heart Rate	Without OCR	With OCR
Basal	90-125 beats/min (median 112 beats/min)	110-130 beats/min (median 120 beats/min)
Muscle dissection	95-122 beats/ min (median 110 beats/ min)	100-115 min (median110/ min)
Maximum traction	90-120 beats/ min (median 115 beats/ min)	80-96 beats/ min median 85 beats/ min
Cutting of muscle	90-120 beats/ min (median 115 beats/ min)	80-96 beats/ min median 85 beats/ min

Table 3: *Heart rate in patients without and with OCR.*

In chi square test, gender ($p = 1.00$), and single muscle surgery were not associated with the occurrence of OCR. Age and two muscle surgery ($p < 0.05$ and $p < 0.05$) were significantly associated with occurrence of OCR. Medial rectus resection was highly associated with a greater occurrence of OCR however, they were not significantly correlated ($p = 0.09$). Results of Lateral rectus recession association with OCR was adjusted as the patients of LR recession did develop OCR but it was during traction of MR.

Discussion

Oculocardiac reflex can have detrimental consequences and has been reported as a common occurrence in strabismus surgeries. In the present study, the OCR was defined to occur if heart rate decreased more than 20% from baseline heart rate. This definition of OCR is in accordance to previous studies [8]. The incidence of OCR in our study was 10.7% which is much lesser as compared to other studies [2,3]. The reasons can be sample size, lesser medial rectus resections or the surgical and anesthetic considerations.

Oculocardiac reflex may be associated with many risk factors like age, gender, baseline heartrate, cardiac problems, anesthetic and surgical considerations. In our study we explored these risk factors, cardiac patients were excluded. Patients in OCR group had a mean age of 12.5 and without OCR mean age was 20.5 yrs., it was found to be a significant association in our study ($p < 0.05$) whereas no significant association was seen with gender and OCR occurrence. Many studies have reported association of occurrence of OCR and pediatric patients as in our study [9-11]. Some studies have shown female preponderance for occurrence of OCR which was not found in our study while most studies are in accordance to our study [1,2,12]. Amongst patients with esotropia and exotropia, a significant association was seen with occurrence of OCR and exotropia. This may be due to the type of surgery done for exotropia. Significant association between exotropia and occurrence of OCR in a study done by Gujjula S., *et al* [13]. All the patients underwent same type of general anesthesia, surgical technique and same surgeon, so these factors seemed unlikely to affect OCR occurrence.

Amongst surgical considerations and association with OCR: baseline heart rate, two muscle vs single muscle surgery, medial and lateral muscle surgery and type of surgery was explored. Baseline heart rate was higher in patients who developed OCR but the result was not significant. Some studies report significant association between lower baseline heart rate and occurrence of OCR which is not in accordance to our study [2]. In two muscle surgery vs single muscle surgery, two muscle surgery was found to be significantly associated with occurrence of OCR which is in accordance to other studies [2,8]. Many studies have reported association of medial rectus surgery and medial rectus resection as a significant risk factor for development of OCR [14-16]. In the present study, we found OCR occurrence more prevalent in medial rectus surgeries and medial rectus resection surgery but the association was not significant ($p = 0.09$). These results may be due to heterogeneity of the population under study. During surgery heart rate decline (OCR occurrence) was seen more prevalent during the traction of the medial rectus muscle during medial rectus resection in our study. The same has been supported by other studies too [8]. In patients who developed OCR after first mechanical stimulation of the extraocular muscle, the counter-regulatory process could lead to the adaption of a subsequent stimulus, due to the occurrence of OCR and the same was observed in our study. Braun., *et al.* reported the adrenergic phase of OCR and it is said to be the counter-regulatory effect that outlasted the period of mechanical stimulation [17].

Limitations of our study were sample size, due to emergence of COVID -19, less patients are opting for elective surgeries. Also, there was imbalance in exotropia vs esotropia surgeries and two muscle vs one single muscle surgery, leading to unbalanced distribution of operated muscles. Also, during surgery, we did not measure the amount of force applied and duration of traction. But the surgeon and technique of surgery was same in all cases, so this factor bias was managed with it.

Conclusion

Oculocardiac reflex prevalence in strabismus surgery was 10.7% in our set up. Age, patients with esotropia and two muscle surgery was a significant risk factor for OCR occurrence. Surgeon needs to be more careful while operating medial rectus muscle in strabismus surgery. The occurrence of OCR may be an important surgical consideration for patients with strabismus.

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