

Occurrence of Oculo Cardiac Reflex During Strabismus Surgery

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Purpose: To evaluate the occurrence of the oculocardiac reflex (OCR) and its associated risk factors during strabismus surgery at a tertiary referral center.

Methods: Over a 8 months period, all strabismus surgery candidates were enrolled in the study. OCR was defined as heart rate reduction $\geq 20\%$ after traction on extraocular muscle(s). The rate of OCR was determined and possible associations were explored. Variables included age, gender, type of strabismus, nature of surgery (weakening versus strengthening), and specified extraocular muscle.

Abstract

Results: Eighty four patients with mean age of 17.2 ± 8.7 years were enrolled. OCR occurred in 24 (28.6%) patients, 57 (36.5%) out of 156 operated muscles, and 18 (21.4%) of 23 GA cases. OCR was more common in subjects less than 20 years of age; however, it showed a decreasing trend afterwards. Postoperative nausea and vomiting (PONV) is significantly associated with the occurrence of OCR. OCR was not correlated with gender, type of strabismus, nature of surgery.

Conclusion: The great majority of patients undergoing strabismus surgery, especially younger subjects, and those undergoing GA experience OCR during surgery.

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Keywords: Oculocardiac reflex, strabismus, PONV, extraocular muscle, anaesthesia.

Introduction

Strabismus is one of the common ocular disorders in children. Significant strabismus left untreated can result in decreased binocularity and amblyopia and could eventually lead to psychosocial problems. Patients of strabismus surgery are at high risk for oculocardiac reflex (OCR). OCR is a physiological response of the heart to physical stimulation of the eye or ocular adnexa. The OCR is defined by the appearance of bradycardic arrhythmia during ocular surgery.¹ It is defined as decrease in heart rate from baseline values by at least 10 to 20%.²⁻⁴ Exaggerated OCR may be life threatening. Based on various published definitions prevalence of OCR ranges from 14% to 90%.⁵⁻⁸ Manipulation of the eye or extraocular muscles during ocular surgery may produce an OCR by stimulating trigeminal nerve branches afferently and by activating the vagus nerve efferently, causing bradycardia or dysrhythmia.^{1,9} In addition to strabismus surgery OCR may be encountered during phacoemulsification cataract surgery,¹⁰ laser in situ keratomileusis surgery,¹¹ orbital surgery,¹² and craniomaxillofacial surgery.¹³ OCR may also lead to asystole.¹⁴ Important complications in squint surgery are OCR and postoperative nausea and vomiting (PONV), and their management requires special attention.^{15,16} In many studies, occurrence of OCR and PONV in relation to the anaesthetic medications were evaluated.¹⁷⁻¹⁹ The possible association between OCR and strabismus surgery rarely been reported.^{2,20} The present study was designed to compare the occurrence of OCR, PONV during strabismus surgery and to determine its associated risk factors in a tertiary referral center.

Patients and Methods

Our study was approved by the scientific and ethics committee of our hospital. This observational study was

conducted at our base hospital for a duration of 8 months i.e., from November 2018 to May 2019. All strabismus surgical candidates were enrolled after obtaining written informed consent from their parents or legal guardians. Demographic characteristics including age and gender were recorded. A comprehensive eye examination including best corrected visual acuity (BCVA), refraction, eye deviation (type, onset, and duration of misalignment) as well as anterior and posterior segment examination was performed for each patient. Patients were excluded if they had a history of bronchial asthma, congenital heart disease, central nervous disease, or other organic dysfunction. All procedures were performed by one surgeon and in a standard manner. In GA after obtaining iv line and cardiorespiratory monitoring iv Midazolam, Glycopyrrolate, Ondansetron, Tramadol were administered as premedication. For induction Thiopentone 5mg/kg, and for facilitating endotracheal intubation Succinyl choline 1mg/kg, Vecuronium 0.1mg/kg were given. Anaesthesia was maintained with nitrous oxide and oxygen an inhalational anaesthetic. Topical anaesthetic 0.5% paracaine drops were used. Subsequently baseline vital signs were recorded. In case of peribulbar block 2% lignocaine with 0.5% bupivacaine is given.

Surgical Procedure

Based on their diagnosis weakening or strengthening procedures were performed by a single surgeon. Surgery of the EOM starts with the placement of lid speculum for adequate exposure. A limbal or cul-de-sac incision was made for better exposure of the appropriate muscles. The muscle is exposed carefully by incising intermuscular membrane and tenons capsule and it is isolated with a Green muscle hook, later further separation of the muscle is done and it

is stabilized by Jameson hook. In weakening procedures, a needle passes through the tendon 1mm away from insertion through both the borders of the muscle and a locking bite suture with 6-0 vicryl was applied. The muscle was cut from its insertion and reattached to sclera posterior to its insertion according to surgical amount. In strengthening procedures, according to the surgical amount a needle passes through the muscle away from the insertion and a locking bite was applied. Then a muscle clamp was used and muscle was cut and reattached to the insertion.

During strabismus surgery, the number and sequence of the operated muscles, HR before giving the anaesthesia (baseline HR), on table after giving anaesthesia, maximum decreased HR after traction of the muscle, HR at 10s and 5 min after traction of muscle, HR at the end of the surgery were collected. A decrease in HR greater than or equal to 20% was taken as the occurrence of oculocardiac reflex.

Statistical Analysis

Occurrence of OCR was compared according to the patient’s age, diagnosis, anaesthesia and between the specific operated muscles. The surgical factors associated with the occurrence of OCR were analyzed. The values of continuous variables are presented as mean and standard deviation; categorical variables are expressed as numbers and percentages. Descriptive and analytical statistics were generated using SPSS 23.0 and JAMOVI/R 1.0. Odds ratio and p value for binomial categorical variables [Anaesthesia] were calculated using Chi-square test and for multinomial variables [muscles] were calculated using logistic regression.

Results

A total of 84 patients, including 46 male (54.8) and 38 female (45.2) subjects with mean age of 17.2 ± 8.7 years were enrolled in this study. Strabismus surgery was performed on both eyes in 19 patients (22.6) while 65 patients underwent surgery on a single eye. Over all, 103eyes were operated including 55(54.2) right and 48(45.8) left eyes. During surgery, OCR occurred in 24 (28.6%) patients. In total, 52 (61.8%) patients were diagnosed as exotropia, 25 (29.8%) were esotropia, 2 (2.4%) were SO palsy, 3 (3.6%) were 6th nerve palsy, 1 (1.2%) monocular elevation defect (MED), 1 (1.2%) congenital fibrosis of extra-ocular muscles (CFEOM). Before surgery mean heart rate of the patients was 106.18±25.97 beats per minute which dropped to 90.05±18.4 beats per minute.

Surgery was performed on 156 muscles of 103 eyes in 84 patients, these included 104 weakening procedures and 47 strengthening procedures. In this study the horizontal rectus muscles were operated most frequently including the lateral (76) and medial (71) recti. Less frequently surgery was performed on the inferior oblique (6) and superior rectus (3) muscles; no surgery as done on inferior rectus and superior oblique muscles. According to the statistical analysis it was found that OCR was more common during operations on medial rectus which was significant. Correlations between age, gender, type of strabismus and nature of surgery are detailed in Table 1&2.

Only 11 out of 84 patients reported with PONV, which was

more common in those with OCR (9 cases in the OCR group in contrast to the 2 cases in the non-OCR group), which was statistically significant (Table 3).

Total number of cases who underwent surgery under GA with topical anaesthesia were 23, of which OCR was observed in 18 cases and in 5 cases OCR was not observed which is statistically significant (Table 4). Similarly out of 61 cases of LA, OCR was observed in 6 cases and in 55 cases OCR was not observed. Patients operated under GA with topical

Table 1: Relationship of oculocardiac reflex and some variables in OCR and non-OCR groups

		Total no	With OCR	Without OCR	p
Age	0-10	20	14 (58.3)	6 (10)	<.001
	11-20	35	7 (29.2)	28 (46.7)	
	21-30	21	3 (12.5)	18 (30)	
	31-40	7	0(0)	7 (11.7)	
	41-50	1	0(0)	1 (1.7)	
Sex	Males	46 (54.8)	11 (45.8)	35 (58.3)	0.298
	Females	38 (45.2)	13 (54.2)	25 (41.7)	
Diagnosis	Exotropia	52 (61.9)	10 (11.9)	42 (50)	0.05
	Esotropia	25 (29.8)	10 (11.9)	15 (17.9)	
	6th nerve palsy	3 (3.6)	2 (2.4)	1 (1.2)	
	MED	1 (1.2)	1(1.2)	0	
	SO palsy	2 (2.4)	1(1.2)	1(1.2)	
	CFEOM	1 (1.2)	0	1(1.2)	

Table 2: Surgical factors stratified by the occurrence of oculocardiac reflex

Operated muscle	OCR (n=24)	Without OCR (n=60)	P
Total no of muscles (n=156)	57 (36.5)	99 (63.5)	0.019
Lateral rectus (n=76)	22 (14.1)	54 (34.6)	
Medial rectus (n=71)	30 (19.2)	41 (26.3)	
Superior rectus (n=3)	1 (0.5)	2 (1.3)	
Inferior oblique (n=6)	4 (2.6)	2 (1.3)	
Nature of surgery			
Recession	40 (70.2)	64 (64.6)	0.320
Resection	14 (24.6)	33 (33.3)	
Transposition	3 (5.3)	2 (2)	

Table 3: Relationship of Postoperative nausea and vomiting (PONV) with OCR

	PONV	Without PONV	p
OCR	9 (37.5)	15 (62.5)	<.001
Without OCR	2 (3.3)	58 (96.7)	

Table 4: Occurrence of OCR in different types of anaesthesia

	OCR (n=24)	Without OCR (n=60)	P value
General Anaesthesia	18 (21.4)	5 (6)	0.030
Local Anaesthesia	6 (7.1)	55 (66.5)	

anaesthetic drops were 3.5 times more likely to have an OCR event [OR3.5, p=0.03] compared to those operated under LA. MR surgeries were twice as likely [OR 2.39, p=0.019] to have an OCR event.

Discussion

The OCR is a common occurrence in strabismus surgery. The incidence of OCR reported in previous studies is greatly varied and depends on the method of evaluation and definition of OCR. In this study, the incidence of OCR was 28.5%. OCR defined as $\geq 20\%$ reduction of heart rate from baseline.

In the early 20th century, Aschner found that bradycardia occurred in the setting of ocular and orbital manipulations. Since then, OCR has been a major concern as a cause of death during strabismus surgery. The higher tonicity of the vagus nerve may be one explanation for the higher chance of this reflex in younger patients.^{2,3,21} In other words, the probability of OCR is reduced with age because of central nervous system maturation.^{2,5,17,20} This study has showed a higher incidence in the <10-year age group and it was significant statistically which is similar to the studies conducted by Lai et al and Dewar et al.^{2,3}

Despite reports of OCR being more common in female subjects, 2-4 in the current study no significant difference was observed with gender which was similar to Apt L et al study.²⁰

In the literature, controversy surrounds the relation between OCR and type of strabismus surgeries. In some published studies, a strong relationship has been reported between the operated muscle and the occurrence of OCR,^{4,8,22-24} while in some others it has not.² Perhaps the heterogeneity of studied populations is the reason for this discrepancy. In the current study, the incidence of OCR was higher during surgery on medial rectus which was similar to the study done by Lai et al, Wehalf et al, Apt et al.^{2,4,20}

Some studies²⁵ have quoted that occurrence of OCR is more with the resection procedure but in our study we did not find any such correlation

The present study and most previous studies found no significant relationship between OCR and the type of strabismus.²

We observed that there is significant association between OCR and PONV in patients undergoing strabismus surgery in our study which was similar to the studies done by Lai YH et al, and Allen et al.^{2,7}

Peribulbar block and the application of topical local anaesthetic drops may provide some antidysrhythmic value by blocking the afferent limb of the reflex arc.²⁶⁻²⁸ Peribulbar block significantly reduced the incidence and severity of OCR compared to the GA group with topical anaesthesia. Topical anaesthetic did not reduce the incidence or severity of OCR compared to the peribulbar group. The majority of the incidences of OCR responded to cessation of operative manipulation. Treatment with atropine was only given in patients who had persistent OCR (> 4 times). We found that topical anaesthetic drops were only marginally effective in obtunding the OCR, whilst the peribulbar block was more effective by anaesthetising the afferent branches of the

trigeminal nerve which was similar to N Gupta et al in his study.²⁹

In summary, the majority of patients undergoing strabismus surgery, especially younger subjects, those undergoing under GA without block, and operation on medial recti, experience OCR during strabismus surgery. Because of the possibility of catastrophic consequences of OCR such as cardiac arrest, this matter requires special attention.

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