Original Article

Comparative effects of different anesthetic regimens on the oculocardiac reflex

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Background: The oculocardiac reflex (OCR), which is most often encountered during strabismus surgery in children, may cause bradycardia, arrhythmias, and cardiac arrest following a variety of stimuli arising in or near the eyeball. The main purpose of this study was to evaluate the effects of various anesthetic regimens on modulation of the cardiovascular response of the OCR during strabismus surgery.
Patients and Methods: Three hundred American Society of Anesthesia (ASA) physical status I-II patients, scheduled for elective strabismus surgery under general anesthesia, randomly allocated in a double blind fashion to one of three anesthetic regimens of group P (propofol 2 mg/kg, alfentanil 0.02 mg/kg, and atracurium 0.5 mg/kg at induction) , group K (ketamine racemate 2mg/kg, alfentanil 0.02 mg/kg, and atracurium 0.5 mg/kg at induction) and group T (thiopental 5mg/kg, alfentanil 0.02 mg/kg, and atracurium 0.5 mg/kg at induction. Mean arterial pressure (MAP) and heart rate (HR) were recorded just before and at 1, 15, 30, 45, and 60 min after induction. OCR was defined as a 20 beats/min change in HR induced by traction compared with basal value.
Results: Mean heart rate (± SD) during the course of surgery in group P was significantly slower than in the K group (111.90 ± 1.10 vs. 116.7 ± 0.70 respectively, $P<0.05$) .Mean HR changes (± SD) in group K was significantly higher than in P group (11.2 ± 1.44 vs. 8.7 ± 1.50 respectively, $P<0.05$). Mean arterial pressure changes (± SD) were significantly lower in group P than in group K or T patients (12.5 ± 1.13 vs. 19.3±0.80 or 18.9±0.91 respectively, $P<0.05$). Frequency of OCR was significantly lower in group K than group T or P patients (9% vs. 16% or 13% respectively, $P<0.05$).
Conclusion: Induction of anesthesia with ketamine is associated with least cardiovascular changes induced by OCR during strabismus surgery.

Key words: Oculocardic reflex, Strabismus surgery, Ketamine, Propofol, Thiopental

Introduction

The oculocardiac reflex (OCR), which is most often encountered during strabismus surgery in children, may cause bradycardia, arrhythmias, and cardiac arrest following a variety of stimuli arising in or near the eyeball[1-3]. The incidence of OCR has been estimated from 32% to 90% in earlier studies[4-7]. Prophylactic anticholinergic is recommended and adequate cardiac monitoring must accompany these interventions as immediate action may be required. OCR may be manifest by bigeminey, ectopic beats, nodal rhythm, and AV block due to traction on extraocular eye muscles (EOM)[8-10].

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Various maneuvers to prevent or minimize the OCR have previously been studied. In contrast, the effects of anesthetic regimes on the reflex have received little attention. The hemodynamic response to the OCR was divided into two phases by Braun and colleagues[11]. The first phase, cholinergic, causes bradycardia and the second phase of the reflex, adrenergic, is described as counterregulation (CR). In addition, a hemodynamic release reaction (RR) is frequently observed during ocular traction release. Anesthetics may influence these various stages of the reflex in different ways. Thus, we designed this randomized double blind study to determine the effect of various anesthetic regimens (propofol/alfentanil/atracurium, ketamine/alfentanil/atracurium, and thiopental/alfentanil/atracurium) on the cardiovascular responses of the OCR during strabismus surgery.

Patients and Methods

After obtaining institutional approval and written informed consent, 300 patients (2-18 years, ASA physical status I or II) who were to undergo elective strabismus surgery were included in a prospective randomized controlled study. Patients with trauma to eye, who had contraindication for using thiopental, ketamine, or propofol, had cardiovascular diseases or had taken cardiovascular drugs were excluded from study. On the day of surgery, all patients arrived in the operating room without premedication. Standard monitoring was applied (the lead II electrocardiogram, pulse oximetry, noninvasive blood pressure monitor). The baseline blood pressure and heart rate (base) were recorded after a resting period of 5 min. Using random number lists, patients were randomly assigned preoperatively to one of three following groups:

Group P: Propofol (2 mg/kg), alfentanil 0.02 mg/kg, and atracurium 0.5 mg/kg at induction.

Group K: Ketamine racemate (2mg/kg), alfentanil 0.02 mg/kg, and atracurium 0.5 mg/kg at induction.

Group T: Thiopental (5mg/kg), alfentanil 0.02 mg/kg, and atracurium 0.5 mg/kg at induction.

Tracheal intubation was performed 3 minutes after atracurium administration. Anesthesia was maintained with continuous propofol infusion at 100 µg/kg/min and 50% nitrous oxide in oxygen. Mean arterial pressure (MAP) and heart rate (HR) were recorded just before and 1, 15, 30, 45, and 60 min after induction. The anesthetist had immediate access to atropine, before the traction of extraocular muscle. During the traction, the minimal heart rate (HR) was recorded and if it was below basal HR by > 20 beats/min, the anesthetist asked the surgeon to release the extraocular muscle. If OCR was not disappeared within 20 seconds by releasing tension on the muscle, atropine 0.01 mg/kg was injected intravenously. Patients were classified as OCR positive, if maximal HR decrement was >20 beats/min, OCR negative if it was ≤ 20 beats/min and arrhythmia positive if patients exhibited cardiac arrhythmia other than bradycardia, otherwise they were classified as arrhythmia negative. A lead II ECG tracing was recorded during stimulation of the reflex for detection of dysrrhythmias.

Statistical Analysis:

Data were analysed using the SPSS (version 11) system on an IBM computer. Continues data were analyzed by one-way analysis

Table1. Data of patients undergoing strabismus surgery and hemodynamic responses to OCR during anesthetic regimens

Parameter	Anesthetic regimes and OCR		
	T	K	P
Number (n)	100	100	100
Age (years)	6.6±0.20	6.70±0.20	6.6±0.20
Weight (Kg)	23.8±0.20	23.9±0.20	23.9±0.20
Sex (M/F)	60/40	58/42	57/43
Total surgery time (min)	62.8±0.23	62.3±0.20	62.8±0.20
Basal HR (bpm)	104.7±1.14	105.2±1.10	104.4±1.17
HR (bpm) (total surgery time)	114.2±0.73	116.7±0.70	111.90±1.10§
HR change (bpm)	11.2±1.44	13.5±0.90*	8.7 ±1.50
Basal MAP (mmHg)	71.0±0.84	72.3±0.90	71.6±0.87
MAP change (mmHg)	18.9±0.91	19.3±0.80	12.5±1.13†
OCR [n (%)]	16(16)	9 (9)#	13(13)

OCR; oculocardiac reflex, HR; heart rate, MAP; mean arterial pressure, T; thiopental, P; propofol, K; ketamine.
Data are given as mean ±SE. § P<0.05 P versus K; * P<0.05 K versus P; † P<0.05 P versus K and T. # P<0.05 K versus P and T by Kendall's W test statistic.

of variance. Two-way analysis (group vs. time) of variance was used to test for differences in hemodynamic data among groups. Chi-square or Fisher's exact tests, when appropriate, was used for discrete data. Bonferroni method was performed for multiple comparisons and P <0.05 was considered significant.

Results:

No patients required intravenous atropine for profound bradycardia during operation and OCR disappeared within 20 seconds by releasing tension on the muscle. Incidence of OCR was 12.7% (38 cases) in 300 patients. It was

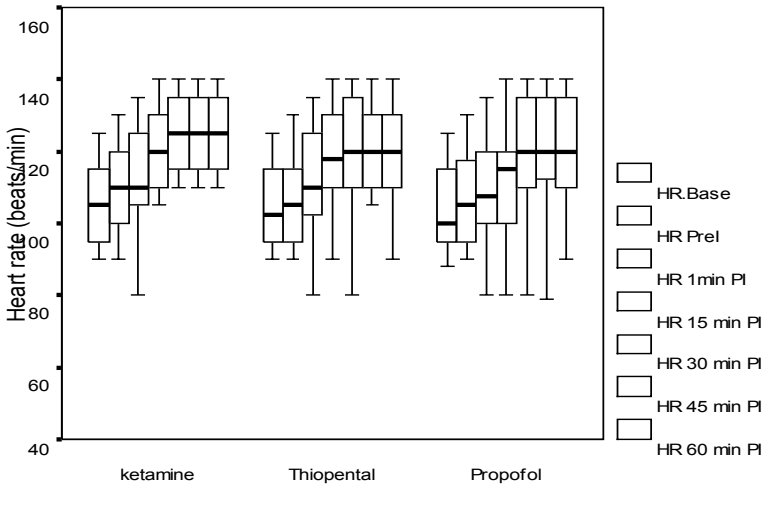

Figure 1. Heart rate changes during surgery based on anesthetic regimens used for induction of anesthesia. Mean heart rate changes in group ketamine were significantly higher than in propofol group. HR; heart rate, PreI; pre induction, PI; Post induction.

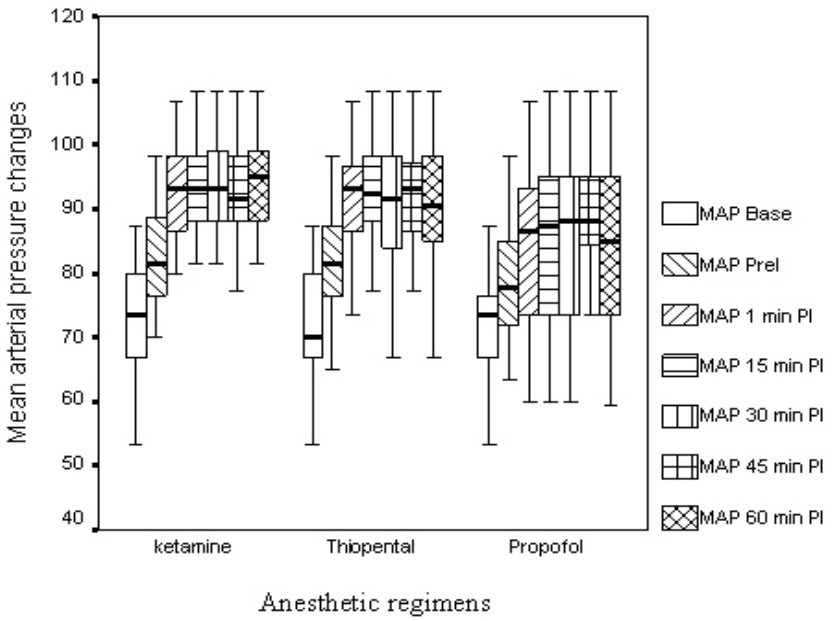

Figure 2. Mean arterial pressure changes during surgery based on anesthetic regimes used for induction of anesthesia. Mean arterial pressure changes were significantly lower in patients in group propofol compared with patients in group ketamine or thiopental. MAP; mean arterial pressure, PreI; Pre induction, PI; Post induction.

slightly more for females than males (51.7% vs 48.3%). Mean age was 6.00 (SE=0.05) years. Mean body weight was 23.9 (SE=0.11) kg and most patients were older than 5 years of age (67% vs 33%). Mean duration of anesthesia was 64.6 (SE=1.83) minutes. There were no statistical differences among the three groups in regard to demographic data (Table 1). There were no significant differences in mean basal HR or mean arterial pressure (MAP) in three groups. Mean HR in group P patients was significantly slower than that of K group during the course of surgery. Mean HR changes in group K was significantly higher than in P group (Fig. 1). MAP changes were significantly lower in patients of group P compared with group K or T cases (Fig. 2). Arrhythmia was not found in any group of the patients. Using Kendall's W tests, the incidence of OCR was significantly lower in patients in group K compared with those in group T or P (Table 1).

Discussion

Although OCR is a frequent and alarming challenge to anesthetists during strabismus surgery, there have been very few studies investigating the influence of anesthetic regimens on the incidence of the OCR. The incidence of OCR determined in earlier studies ranged from 32% to 90%, depending on methods of stimulation and evaluation criteria[12,13]. We demonstrated that different anesthetic have divergent effects on this response. Of particular interest was ketamine as the only anesthetic with sympathetic action. Our study showed that patients receiving propofol or thiopental were more prone to develop pronounced OCR compared with those in ketamine group. The

enhanced vagal tone associated with OCR may act in synergy with the cardiovascular depressant and vagotonic properties of the propofol/alfentanil or thiopental/alfentanil combination[14]. This corresponds to the analysis of randomized controlled trials by Tramer et al. which revealed that propofol, despite the use of prophylactic anticholinergics, substantially increased the incidence of OCR[15]. Despite the fact that group P had the lowest HR at baseline, greatest reduction in HR was still present in this group, during traction on an extraocular eye muscle. In contrast, ketamine seemed to protect against the parasympathetic activation induced by the OCR. This was elicited in only 9 of 100 patients. In view of the hypothesis that the OCR consisted of an initial parasympathetic phase, followed by a sympathetic response[11], ketamine anesthesia may, by increasing sympathetic tone, counteract vagal stimulation during the first phase of the OCR.

Our data suggested that induction of anesthesia with ketamine is associated with least cardiovascular changes induced by OCR during strabismus surgery.

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