

Original Article

Incidence of Oculocardiac Reflex in Pediatric Population Undergoing Corrective Strabismus Surgery: Comparison between Sevoflurane and Total Intravenous Anesthesia

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Abstract

Background: Oculocardiac reflex (OCR) is a life threatening, possible complication of corrective strabismus surgery and is more common among the pediatric patients. Sevoflurane and Propofol are the most commonly used agents in pediatric surgery. This study aimed to compare the effect of these two agents on oculocardiac reflex during corrective strabismus surgery in pediatrics patients.

Materials and Methods: A total of 89 children were divided in two groups and no significant demographic data difference was between the two groups. Group 1 (n=45) received sevoflurane 6-8% as induction agent followed by 2-3% for maintenance, group 2 (n=44) was injected with propofol 3mg/kg as induction agent followed by 200µg/kg/min infusion as the maintenance dose, bispectral index (BIS) was kept 40-60 in both groups. Oculocardiac reflex was compared between the two groups.

Results: Incidence of OCR of group 1 was showed a significant decrease.

Conclusion: Sevoflurane reduced the incidence of OCR. Sevoflurane may be the agent of choice in corrective strabismus surgery, compared to propofol.

Keywords: Oculocardiac reflex, General anesthesia, TIVA, sevoflurane

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Introduction

One of the most common health problems leading to ophthalmic surgery in children is strabismus¹⁻³. Globe manipulation during corrective strabismus surgery may provoke oculocardiac reflex (OCR). Corrective strabismus surgery patients are at high risk for OCR. During this operation, premedication and anesthetic agent can affect the incidence of the OCR. Some studies have shown that general anesthesia, when compared to regional anesthesia,

has a higher incidence of OCR⁴.

In corrective strabismus surgery OCR is always a matter of concern to the anesthesiologists due to its high incidence (32-90%) and serious possible consequences⁶. Risk of OCR could not be eliminated by common prophylaxis⁵. A suitable depth of anesthesia and anti-cholinergics are the mainstay to diminish this risk. There is no standard method available to prevent OCR. A variety of clinical undesirable manifestations from bradycardia to complete heart block and arrest has been reported^{7,8}.

Extraocular muscles traction, applying any pressure on the eyeball and the orbital contents stimulation such as periosteum may result in brady-arrhythmia, or even asystole⁹. An appropriate method to decrease OCR incidence has a significant role in anesthesia management. In this clinical trial study, we aimed to compare the effects of total intravenous anesthesia (TIVA) versus sevoflurane on OCR, and to evaluate if either method could reduce the incidence OCR.

Methods

Ethical committee of Shaheed Beheshti university medical of sciences accepted the study protocol. Routine pre-operative check-up was performed. The children were allowed to take solid food and milk products until 6 hours before the surgery and clear liquids until 3 hours before. Children with allergic reaction to any drugs or any known diseases including central nervous system, cardiopulmonary disease, or other organic dysfunction were excluded. The inclusion criteria were children aged 2-7 years and elective strabismus surgery with parents' permission for participation in the trial. Written informed parental consent was obtained before the study. Eighty-nine children, aged 4-10 years, were selected to undergo surgical correction of strabismus in Labbafinejad eye hospital. The cases planned for elective strabismus surgery by medial rectus manipulation were randomly divided in two groups. Group one was sevoflurane group with 45 patients who received general anesthesia with sevoflurane and group two was propofol group with 44 patients who received general anesthesia with propofol. All patients were premedicated using midazolam 0.05 mg/kg IV, fentanyl 2 µg/kg IV (with lidocaine 1 mg/kg IV for pain relief for propofol injection).

In operation room, a peripheral intravenous route was cannulated. Three-lead electrocardiogram and noninvasive blood pressure, pulse oxymetry, end tidal of CO₂, thermometer and bispectral index (BIS) monitoring were applied, and baseline measurements were documented. Children were pre-oxygenated, induction accomplished as follows in each group: injection propofol 3 mg/kg IV and sevoflurane 6-8 minimal anesthetic concentration (MAC). Laryngeal mask airway (LMA) insertion was facilitated three minutes after atracurium 1mg/kg IV administration.

General anesthesia was maintained with a combination of oxygen, and propofol 200 µg/kg/min in propofol group and 2-3 MAC of sevoflurane in sevoflurane group. Concentration of sevoflurane was changed in accordance to bispectral index (BIS), mean arterial pressure and heart rate (HR). Mechanical ventilation intermittent positive pressure ventilation (IPPV) was used with 8ml/kg tidal volume and respiratory rate of 14-20/min to maintain SPO₂ and ET CO₂ in normal limits. Bispectral index was kept 40-60 in both the group to have adequate depth of anesthesia. Alarms of monitoring devices were set for more range based on basal vital sign. Heart rate was recorded 5 min before the traction and after. More than 20% decrease in heart rate from the baseline was defined as OCR. When OCR occurred during the traction, surgeon was asked to release the tension on the muscle. 0.02 mg/kg of atropine have to be given intravenously if the OCR is not recovered within 20 seconds. When the surgery completed, sevoflurane and propofol were discontinued and residual neuromuscular blockade was reversed using neostigmine 0.07mg/kg and atropine 0.02mg/kg. When the patients started spontaneous respiration and airway reflex was recovered, the LMA was removed. Data were statistically analyzed using SPSS for Windows version 12.0 and expressed as mean ± SD or as number (%). $P < 0.05$ was considered as a significant Statistical difference.

Results

Our study was a clinical trial study performed on 89 patients who were candidates for elective strabismus surgery on medial rectus. Children randomly divided in two groups: propofol and sevoflurane.

Overall incidence of OCR was 49.4% whereas this was 35.5±2% in the sevoflurane and 59±1% in the propofol group (p value=0.007). Demographic characteristics were shown in Table 1. No statistically significant demographic and clinical differences were found between two groups ($p < 0.05$). All enrolled cases analyzed with no missing data.

Discussion

The Oculocardiac reflex, also known as Aschner phenomenon, Aschner reflex or Aschner-Dagnini

Table 1: Demographic characteristics of two groups.

| p-value | total | sevoflurane | propofol | Variables |
|------------------|-------|-------------|----------|-------------------------------|
| P<0.05 | 5±1.9 | 5.2±1.8 | 4.8±2 | Age (years) Mean±SD |
| P<0.05 | 44 | 22 | 22 | Male Sex |
| | 45 | 23 | 22 | female |
| P<0.05 | | 104±22.1 | 92±17.2 | HR |

Table 2: Comparison of OCR between sevoflurane and propofol groups.

| | Overall Incidence of OCR | p value |
|-------------------|--------------------------|---------|
| sevoflurane group | 35.5±2% | |
| propofol group | 59±1% | 0.007 |

reflex, firstly described by Aschner and Dagnini in 1908. The reflex arc is trigeminovagal. The trigeminal nerve is the afferent limb from orbital contents to ciliary ganglion. Vagus nerve is the efferent limb¹¹. Sinus bradycardia is the most common manifestation of OCR but atrioventricular block, ventricular ectopy, ventricular fibrillation, or even asystole may occur during extraocular muscles Traction or the globe pressing¹⁰.

In our study, OCR defined as a decrease in heart rate more than 20% after globe pressing. Incidence differs from 16 to 82% depending on the description of OCR³. Our findings showed the OCR incidence was 49.4%, which was lower comparing with other Iranian study (85.5%). The reasons might be that they did not use any premedication while our patients were pre-medicated by midazolam, fentanyl and lidocaine and OCR defined as 15% decrease in HR in that study. Although the average age was older (15 years) but the incidence was higher¹². We assumed that the incidence decreased by age. Choi et al, showed that when propofol, ketamine, halothane or sevoflurane used as a main anesthetic, the incidence of OCR was lowest in the continuous ketamine infusion, followed by sevoflurane, halothane and propofol¹³. The incidence was reported to be 14% in sevoflurane group comparing with our study (propofol group=59%, sevoflurane group =35.5%) that might be due to older age group.

Anticholinergics agents like atropine are effective to reduce OCR as premedication¹⁴. Atropine is chosen in patients with a history of cardiac conduction

disorders¹⁵. In strabismus corrective surgery, administration of atropine, both IV and IM, is effective to reduce the OCR, even higher doses cannot completely protect against OCR¹⁶. However, we did not use atropine as premedication. We asked the surgeon to stop stimulation instantly when OCR occurred, and only in continued bradycardia, atropine was administered. Most OCR disappears without treatment but in rare cases, OCR may bring with catastrophic results such as cardiac arrest and sudden death¹⁷.

Ketamine reduces the incidence of OCR but it does not eliminate it^{13, 18}. Rajesh et al, showed the OCR incidence can be reduced or eliminated to 20% when peribulbar block along with general anesthesia were used¹⁹. Additionally, use of injection ketamine may be an additional factor for reduction in OCR. Choi et al verified that the incidence of OCR was similar in ketamine and midazolam group in multidrug study¹³. Ketamine dose could be the cause for these results because the former research found that an increase dose of ketamine was associated with lower incidence of OCR²⁰. Higher dose of ketamine accompany with more OCR with a significant outcome²¹. Oh et al, showed that Ketamine did not reduce OCR despite its vagolytic effect²¹. Whereas Espahbodi et al, found that ketamine was associated with a lower incidence of the OCR (20% vs 63% in propofol group) and might be the better choice as an induction drug for eye surgery²².

Bispectral index monitoring is preferred to evaluate the depth of anesthesia. However, it is not available in

every operating room sets in Iran^{23, 24}. Different studies concluded that the lower BIS continuous with the lower OCR. In an Iranian study the lowest incidence of OCR was seen in BIS =40 by 20%²⁵. Karaman et al, revealed that the depth of anesthesia lessens the incidence of OCR. However, even with monitoring methods such as BIS, prevention of OCR is not ensured²³. For these reasons, we kept BIS in range of 40-60. The other influencing factor is the type of the muscle involvement. In some studies, OCR incidence was higher by medial rectus traction than lateral although they had BIS of 50^{23, 26}.

Allison et al, demonstrated that sevoflurane decrease vagal activity more than halothane²⁷. In patients with sevoflurane bradycardia was less seen, when OCR happened. Compared with sevoflurane and other volatiles, desflurane is the only agent increases sympathetic activity, and does not increase the incidence of OCR due to its vagolytic effect, which is more powerful than sympathetic activity therefore the heart rate during steady-state anesthesia with desflurane increases. Sevoflurane is preferable for low blood-gas partition coefficient and non-pungency in pediatric surgery. As such, we concluded that sevoflurane was safe and had less influence on OCR. We predicted lower incidence of OCR in sevoflurane group than in propofol group, which was in compatible with other studies²⁸⁻³⁰.

Our study had some limitations. First, the small sample size which could disturb the exact result. Second, the definition of OCR was too strict so that actual outcomes could not be made. In different articles the incidence of OCR diverse by definition. Third, our study performed in a teaching hospital where the surgery group was variable. Finally, maintaining the same depth of anesthesia is difficult, since age, body weight can influence mean alveolar concentration of sevoflurane. Besides blinding the investigator team was impossible due to anesthetic agents.

Conclusion

In conclusion, we found that sevoflurane reduced the incidence of OCR. Comparing with propofol so it may be the agent of choice in corrective strabismus surgery in children.

Acknowledgment

None.

Conflict of Interest

The authors declare that there is no conflict of interests.

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