The Effects of Tracheal Intubation on Changes of Intraocular Pressure after Sevoflurane-N2O Anaesthesia Induction in Children without Use of Muscle Relaxants

Çocuklarda Trakeal Entübasyonun Kas Gevşetici Kullanmaksızın Yapılan Sevofluran-N2O Anestezi İndüksiyonundan Sonra Göz İçi Basıncına Etkisi

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Abstract
Purpose: Laryngoscopy and tracheal intubation may be associated with an acute increase in intraocular pressure and arterial blood pressure. We aimed to investigate the effects of laryngoscopy and tracheal intubation after anaesthesia induction with 8% sevoflurane in O_2-N_2O mixture without muscle relaxant, on the blood pressure, heart rate and intraocular pressure in children.
Material and Methods: This study was performed in 30 children, undergoing elective non-ophthalmic surgery. Anaesthesia was induced (8%) and maintained (2-3%) with sevoflurane in nitrous oxide and oxygen. No muscle relaxant was used. IOP was measured first after induction, then 1, 3, 5 min after intubation, and just 1 min before and 1, 3 min after extubation. heart rate, arteriel blood pressure, peripheral oxygen saturation values were recorded after anesthesia induction, after intubation 1st, 3rd and 5th minute, just before extubation and 1, 3 and 5 minute later.
Results: The average age was 35.82±0.17 months and average weight was 14.57±4.23 kgs. Changes for intraocular pressure was not significantly different ($p>0.05$). Any complication such as respiratory depression, nausea-vomiting, laryngospasm were not observed after induction, intubation and extubation in the children.
Conclusion: Although we did not administer any muscle relaxant, increase in IOP has not been observed during laryngoscopy and intubation.

Key Words: **Intraocular Pressure; Intubation; Sevoflurane.**

Özet
Amaç: Laringoskopi ve trakeal entubasyon intraokuler basınç ve arteriyel kan basıncını artırmaktadır. Bu çalışmada; çocukların göz dışı cerrahilerinde kas gevşetici kullanmaksızın O_2-N_2O karışımı içinde 8% sevofluran anestezisi indüksiyonunu kan basıncı, kalp atım hızı ve göz içi basıncı üzerine etkisini araştırmayı amaçladık.
Gereç ve Yöntem: Bu çalışma göz ameliyatı harici elektif cerrahi yapılan 30 çocukta gerçekleştirildi. Anestezi 8% sevofluran ile indüksiyondan sonra nitröz oksit ve oksijen karışımı içinde 2-3 % sevofluran ile sürdürüldü. Kas gevşetici kullanılmadı. Göz içi basıncı indüksiyondan sonra, intubasyondan 1, 3, 5 dakika sonra, ekstubasyondan hemen 1 dakika önce ve 1 ve 3 dakika sonra bakıldı.
Bulgular: Laringoskopi ve endotrakeal tüpün yerleştirilmesi bütün çocuklarda kolayca başarıldı. Sistolik ve diastolik kan basıncı indüksiyon sonrasından ekstubasyon öncesine kadar olan sürede indüksiyon öncesi değere göre düşük seyretti. Kalp atım hızında ise indüksiyonun 3. dakikasından ekstubasyon sonrası 5. dakikaya kadar sürede indüksiyon öncesi değere göre düşük seyretti ($p<0,05$). İntraoküler basınç değerlerinde ise farklılık görülmedi ($p>0,05$). İndüksiyon, entübasyon ve ekstübasyondan sonra respiratuvar depresyon,bulantı, kusma ve laringospazm gibi herhangi bir komplikasyon ise görülmedi.
Sonuç: Çocuklarda kas gevşetici kullanılmamasına rağmen laringoskopi ve entübasyon sırasında göz içi basıncı, sistolik, diastolik kan basıncı ve kalp atım hızında artış olmamıştır.

Anahtar kelimeler: **Çocuk; Entübasyon; Göz içi basıncı; Sevofluran.**

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Introduction

Anaesthesia is usually induced with inhalation of volatile agents via facemask, especially in paediatric patients without intravenous access. Although halothane has been used as the main drug for inhalation induction of anaesthesia, sevoflurane has several advantages over halothane. Sevoflurane has fewer myocardial depressant effects than halothane (1) and it is less extensively metabolised (2). It has a lower solubility in blood (3) and a pleasant smell (2) permitting smooth induction and tracheal intubation without muscle relaxant (4). Moreover, sevoflurane would be expected to produce a more rapid anaesthetic induction for tracheal intubation than halothane (5). Endotracheal intubation is usually facilitated with muscle relaxants after induction, but it can be performed without muscle paralysis due to small muscle relaxation provided by volatile anesthetic in children. This method is a common practice among members of the Society for Paediatric Anaesthesia (4, 6).

Intraocular pressure (IOP) is maintained in the normal eye between 15-20 mmHg by a balance between the volume of aqueous humor, vitreus and chorioid vasculature and outward pressure from inside the globe, scleral compliance and extraocular muscle tone which press inwards (7). IOP measurements in children are frequently performed under general anesthesia; however, anesthesia facemasks may limit access to the eyes, and tracheal intubation is associated with transient increases in IOP, arteriel blood pressure (ABP) and heart rate (HR). The purpose of this study was to investigate the changes of IOP, ABP and HR after tracheal intubation during sevoflurane-N_2O anaesthesia without the use of muscle relaxants in children who planned non-ophthalmic surgery.

Materials and Methods

This study was performed in 30 children, ASA physical status I or II and undergoing elective non-ophthalmic surgery, approved by Erciyes University, Medical Faculty Ethical Committee and informed consent by the parent of children. The children were aged between 12-84 months. Premedication was omitted. In the operating room, HR, non-invasive ABP, peripheral oxygen saturation (SpO_2) (Datex-Engstrom AS/3, Finland) were monitored for the children. After endotracheal intubation, gases for measurements were sampled from the angle piece placed at the distal end of the tracheal tube. Anesthesia was induced with sevoflurane 8% in 66% N_2O and O_2 in all children via facemask with Mapleson B circuit for all children. Following the anesthesia induction, laryngoscopy and endotracheal intubation was performed by the same anesthetist after the pupils are centered. Anesthesia was maintained with 2.5-3% sevoflurane in 66% N_2O and O_2 with semi-closed pediatric anaesthesic system for all children. IOP measurements were performed by same chief ophtalmologist. A Schiötz tonometer was used to measure the IOP. Two readings were taken in the right and left eye at each measurement time, the mean of the two readings was recorded. In all children, caudal blockade was performed for postoperative analgesia after tracheal intubation and IOP measurements. IOP was measured first after induction, then 1, 3, 5 min after intubation, and just 1 min before and 1, 3 min after extubation. Because of difficulties in unpremedicated children, IOP was not measured preoperatively. HR, ABP, SpO_2 values were recorded after anesthesia induction, just before application of i.v. cannulae; after intubation 1st, 3rd and 5th minute, just before extubation and 1, 3 and 5 minute later. At the end of operation, when the skin closure was started, N_2O administration was terminated, 1-1.5% sevoflurane in 100% O_2 was continued. The children were extubated after return of spontaneous ventilation and sevoflurane vapourizer closed.

Results are expressed as mean±standard deviation (mean±SD). A repeated measure of ANOVA was used for serial data the changes of IOP, HR, sistolic blood pressure (SBP), diastolic blood pressure (DBP) and $p<0.05$ was considered statistically significant.

Results

The average age was 35.82±0.17 months and average weight was 14.57±4.23 kgs. Laryngoscopy and endotracheal intubation were easily accomplished in all children. SBP and DBP values were significantly lower during the after induction to before extubation than before induction ($p<0.05$). HR value was significantly lower during the 3 minutes after induction to 5 minutes after extubation than before induction ($p<0.05$) (Table 1). But there were no significant changes serial measured in terms of IOP ($p>0.05$) (Table 2). Any complication such as respiratory depression, decrease of SpO_2, nausea-vomiting, laryngospasm were observed induction, intubation and extubation in all children.

Table 1. The changes of systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate (HR) values in children.

	SBP (mmHg)	DBP (mmHg)	HR (Beat / min)
Before induction	115.0±15.55	72.66±10.97	128.08±19.34
After induction	107.04±18.44*	62.43±13.64*	116.96±26.58
After intubation 1st min	109.7±16.48*	63.95±10.57*	123.23±23.01
3rd min	104.0±14.26*	58.91±8.68*	121.46±20.62*
5th min	98.79±15.75*	55.37±10.31*	118.26±18.1*
Before extubation	101.45±16.24*	59.63±11.76*	112.58±16.51*
After extubation 1st min	109.5±18.28	69.54±16.27	123.78±16.81*
3rd min	113.73±16.46	73.1±13.64	112.68±16.06*
5th min	114.71±17.71	69.0±16.54	104.62±25.32*

Values are mean ±standard deviation. * Statistically significant difference versus befor induction ($p<0.05$)

Table 2. The changes of intra ocular pressure (IOP) in left and right eye (mmHg)

	Right eye	Left eye
After induction	14±3.01	16±3.44
After intubation 1st min	16±3.61	17±4.02
After intubation 3rd min	15±3.29	16±3.43
After intubation 5th min	15±3.58	15±3.24
Before extubation	16±3.06	17±3.58
After extubation 1st min	16±2.62	18±3.6
After extubation 3 rd min	15±2.45	16±2.65

Values are mean standard deviation. There were no significant changes right and left eye IOP versus after induction ($p>0.05$).

Discussion

In this study, we found that performed laryngoscopy and endotracheal intubation after anaesthesia induction with sevoflurane 8% in N_2O 66% and O_2 mixture do not cause any significant change in IOP and do not cause any high systolic blood pressure, diastolic blood pressure and HR. The results from this study are different than those of Duman et al (8) who concluded that the insertion of endotracheal tube during sevoflurane anaesthesia is associated with significant cardiovascular and IOP changes. This difference may be explained that N_2O was not used during anesthesia induction in their study.

For measurement of IOP in children, usually general anaesthesia is necessary. The facemask causes external compression of the globe during general anaesthesia via a facemask, the measurement of IOP requires put the mask away, therefore it may cause waking up and moving. Since usage of anesthetics with together muscle relaxants is a commonly accepted method in general anesthesia through endotracheal way, so intubation has been achieved with neuromuscular blocking drugs. Especially when attention is paid to measurement of IOP, short acting succinylcholine may cause an undesirable rise in IOP which can be misinterpreted. Using a nondepolarizing muscle relaxant to provide only measurement of IOP is not a practical application. In the present study, administered induction resulted adequate intubating conditions, no changes were observed with regard to the haemodynamic parameters (HR, SBP and DAP), so it suggests that to facilitate the tracheal intubation, neuromuscular blocking agents are not absolutely neccessary in children. Without using a neuromuscular blocker in deeply anaesthetized children, extubation is safe with regard to the residual effects of neuromuscular blocking agents and has no obvious complications.

Preventing an increase in IOP is essential aim of anaesthetic management during ocular surgery. It has been shown that the inhalation anaesthetics reduce IOP via their central depressive effect on the diensephalic control of IOP, relaxing extraocular muscle tone and improving the aqueous humour outflow (9,10). Laryngoscopy, endotracheal intubation and extubation are the anaesthesia-related practices most likely to increase IOP, tachycardia and hypertension probably via mechanisms that stimulate the sympathetic nervous system (1, 9). To facilitate the endotracheal intubation, succinylcholine administration increases IOP (11, 12). It has been shown that mivacurium pretreatment significantly attenuates the increase in IOP in response to suxamethonium (12). When an increase in IOP is undesirable, such as in cases of penetrating eye injury, pancuronium and vecuronium have been used instead of suxamethonium, although both these agents provide less than optimum condition for rapid intubation. Therefore, there is a need for a method that can successfully prevent suxamethonium-induced increses in IOP. In the present study, although we did not administer any muscle relaxant, increase in IOP, SBP, DBP and HR have not been observed during laryngoscopy and intubation.

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