European Journal of Ophthalmology / Vol. 10 no. 2, 2000 / pp. 105-109

The effect of propofol and alfentanil on the increase in intraocular pressure due to succinylcholine and intubation

Z. ETİ [1], A. YAYCI [1], T. UMUROĞLU [1], F.Y. GÖĞÜŞ [1], N. BOZKURT [2]

[1] Department of Anesthesia and Reanimation
[2] Department of Ophthalmology, Medical Faculty of Marmara University, Istanbul - Turkey

PURPOSE. *The aim of this study was to evaluate the effects of propofol and alfentanil on the increase in intraocular pressure (IOP) due to succinylcholine and intubation, in comparison with thiopental sodium and vecuronium bromide.*

METHODS. *Forty patients aged 20-50 years, scheduled for elective surgery requiring endotracheal intubation, were assigned to four groups of ten. General anesthesia was induced with 2.5 mg/kg propofol in Group I, 2.5 mg/kg propofol and 10 µg/kg alfentanil in Group II and 5 mg/kg thiopental in Groups III and IV; muscle relaxation was obtained with either 1.5 mg/kg succinylcholine (Group I, II and III) or 0.1 mg/kg vecuronium bromide (Group IV). In all patients mean arterial pressure, heart rate, oxygen saturation and IOP were recorded before (baseline) and after induction, after the muscle relaxant and after endotracheal intubation.*

RESULTS. *Compared with their baseline values in Group I IOP decreased significantly after propofol ($p<0.01$) and increased significantly after intubation ($p<0.01$). In Group II IOP decreased significantly after propofol and alfentanyl ($p<0.001$), remained low after succinylcholine ($p<0.01$) and did not change after intubation. In Group III IOP decreased significantly after thiopental ($p<0.001$) and increased significantly after intubation ($p<0.001$). In Group IV it decreased significantly after thiopental ($p<0.001$), remained low after vecuronium ($p<0.001$) and increased significantly after intubation ($p<0.05$).*

CONCLUSIONS. *In all Groups, IOP did not increase significantly after succinylcholine, but only anesthesia induced with propofol and alfentanil prevented the increase in IOP due to intubation. (Eur J Ophthalmol 2000; 10: 105-9)*

KEY WORDS. *Intraocular pressure, Propofol, Alfentanil, Succinylcholine, Intubation*

Accepted: May 17, 1999

INTRODUCTION

The anesthetic management of the patient with a penetrating eye injury who has recently eaten is a challenging situation for the anesthesist. The anesthetic technique chosen must balance the risk of aspiration of gastric contents with the risk of visual loss in the event of increased intraocular pressure (IOP) and vitreous expulsion secondary to coughing, vomiting or drug effect (1).

Succinylcholine, a depolarizing neuromuscular blocker, is commonly used to facilitate rapid tracheal intubation in patients at risk for aspiration of gastric contents, and offers the advantages of rapid onset, smooth intubating conditions and short duration of action (1, 2). However, it raises IOP by a direct effect on extraocular extrafusal muscle tension, and has a cycloplegic action with deepening of the anterior chamber and increased outflow resistance. In addition laryngoscopy and endotracheal intubation increase IOP more

 1120-6721/105-05$02.50/0

than the increase attributed to succinylcholine (2, 3). Several drugs including anesthetics and vasoactive agents have been used to attenuate this response but none of them consistently blunts the IOP response to succinylcholine and intubation (4-8).

This study was undertaken to evaluate the effects of propofol and alfentanil, which provide excellent hemodynamic variables and intubating conditions during anesthesia induction, on the increase in IOP due to succinylcholine and endotracheal intubation.

MATERIALS AND METHODS

After approval from the institutional ethics committee and patients' written consent, 40 patients, aged 20-50 years, ASA physical status I-II were enrolled in the study. All patients were scheduled for elective non-ophthalmological surgery requiring endotracheal intubation. The patients were preevaluated by an ophthalmologist. Exclusion criteria included ocular pathology, respiratory or cardiovascular disease.

The patients were randomly assigned to four groups of ten. To prevent bias we arranged the groups by drawing lots and assigned the patients to the groups in order of arrival at the theater. The patients were not premedicated.

Group I was given 2.5 mg/kg propofol, Group II 2.5 mg/kg propofol and 10 µg/kg alfentanil, Group III and IV 5 mg/kg thiopental for anesthesia induction. Muscle relaxation was achieved with 1.5 mg/kg succinylcholine in Groups I, II, III and 0.1 mg/kg vecuronium bromide in Group IV. All patients were intubated endotracheally.

After topical anesthesia with one drop of 0.4% benoxinate solution (oxybuprocaine), IOP was measured using a Schioltz tonometer on the right eye before induction of anesthesia (baseline), after administration of the induction agents, after the muscle relaxant and after intubation. Heart rate, mean arterial pressure (MAP) and oxygen saturation were measured at the same times. The time to onset of complete neuromuscular blockade with vecuronium was determined using a peripheral nerve stimulator delivering a train-of-four stimulation.

For statistical analysis, repeated measures of variance (multivariate ANOVA) were used to assess changes over time in groups and the Tukey-Kramer multiple comparison test was used for post-hoc comparison. One-way ANOVA was used to assess differences between Groups; $p<0.05$ was considered statistically significant.

RESULTS

There were no significant differences in the basic demographic characteristics of patients in the four groups (Tab. I). The baseline IOP values were not different. Compared with their baseline values, in Group I IOP decreased significantly after propofol ($p<0.01$) and increased significantly after intubation ($p<0.01$); the increase after succinylcholine was not significant. In Group II IOP decreased significantly after propofol and alfentanyl ($p<0.001$), remained low after succinylcholine ($p<0.01$) and did not change after intubation. In Group III it decreased significantly after thiopental ($p<0.001$) and increased significantly after intubation ($p<0.001$); the increase after succinylcholine was not significant. In Group IV IOP decreased significantly after thiopental ($p<0.001$), remained low after vecuronium ($p<0.001$) and increased significantly after intubation ($p<0.05$). IOP after intubation was significantly lower in Group II than the other Groups ($p<0.01$) (Tab. II).

Compared with baseline MAP decreased significantly after propofol (Group I) and after propofol-alfentanil (Group II) ($p<0.001$). After intubation, MAP increased significantly in Groups I, III and IV ($p<0.001$) but not in Group II. MAP after intubation was significantly lower in Group II than the other Groups ($p<0.01$) (Tab. III).

Heart rate did not change in Group II. It rose significantly after induction ($p<0.01$) in Groups I and III and after intubation ($p<0.001$) in Groups I, III and IV. Heart rate after intubation was significantly lower in Group II than the other Groups ($p<0.01$) (Tab. IV).

DISCUSSION

For emergency open-eye surgery, in a patient with a full stomach, succinylcholine offers the advantages of rapid onset of relaxation, smooth intubating conditions and short duration of action. However, succinylcholine and intubation raise IOP (1-3). All the induction agents used in this study (propofol, propofol-alfentanil and thiopental) prevented the rise in IOP after succinylcholine. However, with laryngoscopy and

TABLE I - BASIC CHARACTERISTICS OF PATIENTS (MEAN±SD)

	Group I	Group II	Group III	Group IV
Age (years)	36.00 ± 10.11	33.40 ± 9.97	34.90 ± 9.48	33.90 ± 9.81
Weight (kg)	66.00 ± 8.19	67.69 ± 55	66.6 ± 9.78	64.8 ± 7.28
Height (cm)	168.0 ± 5.36	167.5 ± 7.50	166.0 ± 4.82	166.0 ± 7.85
Sex (M/F)	5/5	6/4	5/5	6/4

TABLE II - INTRAOCULAR PRESSURE (mmHg) (MEAN ± SD)

	Group I	Group II	Group III	Group IV
Baseline	13.25 ± 2.78	16.35 ± 3.21	17.35 ± 3.30	15.83 ± 5.06
Induction	7.84 ± 1.98**	10.25 ± 4.41**	10.55 ± 2.54**	10.27 ± 3.89**
Muscle relaxant	11.55 ± 4.2	12.75 ± 4.01*	16.05 ± 2.97	9.94 ± 2.87**
Intubation	20.5 ± 4.92**	15.50 ± 3.97#	26.00 ± 7.06**	19.16 ± 6.94*

*p<0.01, **p<0.001 compared with baseline
#p<0.01 compared with other groups

TABLE III - MEAN ARTERIAL PRESSURE (mmHg) (MEAN±SD)

	Group I	Group II	Group III	Group IV
Baseline	93.00 ± 13.85	88.2 ± 9.00	89.2 ± 12.7	91.5 ± 9.11
Induction	73.00 ± 7.06**	64.2 ± 10.4**	80.5 ± 7.09	85.2 ± 9.64
Muscle relaxant	82.50 ± 13.73	70.1 ± 11.0	101.8 ± 15.0	84.3 ± 13.3
Intubation	116.50 ± 10.56*	90.4 ± 12.6#	127.4 ± 20.4**	133.3 ± 16.7**

*p<0.01 and **p<0.001 compared with baseline
#p<0.001 compared with other groups

TABLE IV - HEART RATE (BEATS MIN) (MEAN ± SD)

	Group I	Group II	Group III	Group IV
Baseline	85.50 ± 19.33	91.3 ± 14.0	84.4 ± 14.8	86.0 ± 16.9
Induction	100.0 ± 16.40*	80.0 ± 14.2	98.4 ± 12.5*	98.0 ± 18.2
Muscle relaxant	108.0 ± 10.13*	84.3 ± 13.3	99.7 ± 16.9*	93.1 ± 14.6
Intubation	118.5 ± 14.54**	86.3 ± 14.4#	112.8 ± 16.6**	112.3 ± 15.7**

*p<0.05 and **p<0.001 compared with baseline
# p<0.01 compared with other groups

intubation IOP rose more than with succinylcholine and only propofol and alfentanil could prevent this.

All central nervous system (CNS) depressants including inhaled agents, barbiturates, neuroleptics, hypnotics and narcotics, lower IOP directly through an action on the central diencephalic control centers, reduction of aqueous humor production, enhancement of outflow and relaxation of the extraocular muscles (1,3-8). However none of them completely prevents the rise in IOP due to succinylcholine and especially due to intubation. Mirakhur et al. (4) showed that propofol reduces IOP more than thiopental but does not prevent the increase that occurs with intubation unless a second dose is given just before intubation. Although our findings confirm that induction of anesthesia with propofol or thipental is associated with a significant decrease in IOP, we did not find any significant difference between the agents.

Mirakhur et al (5), in another study, compared the effects of propofol and thiopental on IOP after intubation with vecuronium and concluded that although IOP after intubation was not different from baseline in either the propofol or thiopental group, the decrease was greater with propofol. However, in our IVth Group thiopental and vecuronium did not prevent the increase in IOP due to intubation. This differences may be due to the fact that they administered fentanyl to their patients before induction.

Sweeney et al (6) studied the effects of fentanil and alfentanil on the IOP response to suxamethonium and tracheal intubation, inducing anesthesia with thiopental. They concluded that the increases in IOP after succinylcholine and intubation were significant although they were not higher than the control values. Kovac et al (7) studied the effect of esmolol after 10 µg/kg alfentanil on hemodynamics and IOP response to succinylcholine and intubation and concluded that it prevented the increase in heart rate but not in MAP or IOP.

In our study co-administration of the same dose of alfentanil with propofol prevented the increase in IOP and we assumed this effect could not be attributed to alfentanyl or propofol alone but to the combination. Artru (9) studied the mechanism of the effects of propofol on IOP in rats and found that the drug significantly altered aqueous humor dynamics in the anterior chamber, reducing aqueous formation by 24%. Besides the effects on aqueous formation, our data showed that propofol and alfentanyl prevented the hemodynamic response to intubation by establishing a sufficiently deep level of anesthesia, while MAP and heart rate rose significantly after intubation in Groups I, III and IV.

Using a barbiturate and an intubating dose of a non-depolarizing muscle relaxant is often described as the method of choice for the emergency repair of a ruptured globe as non-depolarizing muscle relaxants do not raise IOP, as confirmed in this study (8-11). This technique, however, has serious disadvantages including the risk of aspiration during the relatively long time the airway is unprotected. Moreover a premature attempt at intubation triggers coughing, straining and a substantial increase in IOP with detrimental hemodynamic consequences. In a study by Abdulla et al. (8), atracurium was not endorsed as an alternative to succinylcholine for patients with penetrating eye injuries and a full stomach despite the fact that it lowers IOP as it could not produce intubation conditions comparable to succinylcholine. Besides, non-depolarizing blockers do not prevent the increase in IOP due to intubation.

In conclusion, propofol and alfentanyl prevented the increase in IOP due to succinylcholine and intubation. This induction technique should therefore be preferred in patients with penetrating eye injury and a full stomach.

Reprint requests to:
Zeynep Eti, MD
Marmara Üniversitesi Hastanesi
Anesteziyoloji ve Reanimasyon Anabilim Dali
Tophanelioğlu cad. No: 13-15, Altunizade
81190 Istanbul, Turkey

REFERENCES

1. Cunningham AJ, Barry P. Intraocular pressure-physiology and implications for anesthetic management. Can Anaesth Soc J 1986; 33: 195-208.
2. Meistelman C, McLoughlin C. Suxamethonium - Current controversies. Current Anaesthesia and Critical Care 1993; 4: 53-8.
3. Frawley P. A review of anesthesia for the open globe. CRNA 1992; 3: 30-4.
4. Mirakhur RK, Shepherd WF, Darrah WC. Propofol or thiopentone: Effects on intraocular pressure associated with induction of anaesthesia and tracheal intubation (facilitated with suxamethonium). Br J Anaesth 1987; 59: 431-6.
5. Mirakhur RK, Shepherd WF, Elliott P. Intraocular pressure changes during rapid sequence induction of anesthesia: Comparison of propofol and thiopentone in combination with vecuronium. Br J Anaesth 1988; 60: 379-83.
6. Sweeney J, Underhill S, Dowd T, Mostafa SM. Modification by fentanil and alfentanil of the intraocular pressure response to suxamethonium and tracheal intubation. Br J Anaesth 1989; 63: 688-91.
7. Kovac AL, Bennets PS, Ohara S. Effect of esmolol on hemodynamics and intraocular pressure response to succinylcholine and intubation following low dose alfentanil premedication. J Clin Anesth 1992; 4: 315-20.
8. Abdulla WY, Flaifil HA. Intraocular pressure changes in response to endotracheal intubation facilitated by atracurium or succinylcholine with or without lidocaine. Acta Anaesth Belg 1992; 43: 91-101.
9. Artru AA. Trabecular outflow facility and formation rate of aqueous humor during propofol, nitrous oxide and halothane anesthesia in rabbits. Anesth Analg 1993; 77: 564-9.
10. Jantzen JP, Hackett GH, Erdmann K, Earnshaw G. Effect of vecuronium on intraocular pressure. Br J Anaesth 1986; 58: 433-6.
11. Schneider MJ, Stirt JA, Finholt DA. Atracurium, vecuronium and intraocular pressure in humans. Anesth Analg 1986; 65: 877-82.