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Comparative Evaluation of Intraocular Pressure and Hemodynamic Changes During Tracheal Intubation and Extubation

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Abstract: Intraocular Pressure (IOP) may increase during general anesthesia due to intubation. Increasing of IOP in some surgical procedures may lead to complications and it is important to reduce IOP. The changes of the IOP and haemodynamic variable are evaluated during intubation and extubation at the end of general anesthesia. In this study, 51 patients were selected for orthopedic and general surgery. A standard general anaesthesia was treated to all of the patients. For maintaining airway during anesthesia, the patients were received directly laryngoscopy intubing technique. Intraocular pressure was measured at different stages prior to intubation and extubation and then at 1, 5 and 10 min after intubation and extubation with shiutze tonometer by a trained and expert person. The Blood Pressure (BP) and Heart Rate (HR) were measured. Results show that tracheal intubation and extubation cause increase in IOP at 1, 5 min after intubation. The highest increase in IOP level occurs one minute after extubation (43.41%). It was not significantly between increasing in IOP during above mentioned extubaion period. Intubation and extubation caused increase BP and heart rate. The highest increase in BP and heart rate happens at the first minute after intubation (30.63, 14.86%). It statistically was difference between increasing in the BP and HR during intubation and extubation ($p<0.05$). Although IOP level was significantly increased but it was normal range. With the regards to increase in IOP level during extubation compare to intubation at prior and 1 min after intubation, it is recommended that the more accurate planning to prevent increasing of above-mentioned changes at the time of intubation.

Key words: Intraocular pressure, tracheal intubation, extubation, haemodynamic

INTRODUCTION

Tracheal intubation is a time-tested method to achieve the airway control in anesthesia practice and resuscitation. Tracheal intubation is one of the important techniques during anesthesia to secure patient air way. However, tracheal intubation and extubation during anesthesia may be associated with significant risks (Ghai *et al*., 2001; Casati *et al*., 1999). Airway control with tracheal during general anesthesia can be associated with increaseing in Intraocular Pressure (IOP) due to an increase in blood pressure and blood flow to the eye (Bukhari *et al*., 1999). In human, the normal range for IOP is approximately 16±5 mm Hg and values greater than 24 mm Hg are considered pathologic condition. It is important to evaluate the changes of haemodynamic parameters during general anesthesia (Sator *et al*., 1998; Vinik, 1999; Hwang *et al*., 2006).

Attempts have been made to reduce IOP by administration of sedative, narcotics and relaxant drugs at the beginning of anesthesia and induced good condition of deep unconsciousness, but irritation of intubation may lead to increase of IOP and changes of cardiovascular parameters. Different methods have been proposed to inhibit these changes, but during extubation, the depth of anesthesia generally declines and the effect of the muscle relaxant drugs will be terminated, therefore intraocular pressure and cardiovascular conditions will extensively change at extubation. Direct-vision laryngoscopy and endotracheal intubation are known to affect the hemodynamice parameters and IOP level. Increasing in IOP occurs early after intubation (20 sec) and disappears after 1 or 2 min. The stress response to tracheal intubation, its effects on heart rate, blood pressure and IOP can be attenuated by pre medication (Casati *et al*., 1999; Kubitz and Motsch, 2003).

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For preventing unwanted complication, it is necessary to keep constant intraocular pressure and or cardiovascular condition at end of general anesthesia. Therefore, this trail was designed to compare the changes in the IOP and haemodynamic parameters due to intubation and extubation in patients under general anaesthesia. There are many studies to show that intubation to increase IOP, it is not enough study to provide any relation between extubation and IOP. It is important to care which deep anesthesia is observed during intubation but patients are removing from anesthesia condition during extubation.

After extubation, HR and adrenaline concentration increased at 5 min after extubation (Lowrie *et al*., 1992) it is relation between IOP and blood pressure (Rochtchina and Mitchell, 2002).

MATERIALS AND METHODS

After obtaining permission from medical ethics committee of the university and patient's agreement, this sequential trial was conducted in Boali Hospital in Mazandaran University of Medical Sciences on 51 patients ASA grade I and II (Class 1 and 2, based on the classification of American Society for Anesthesiology), ASA class I: No organic, phsiologic, biochemical, or psychaitric disturbance; ASA class II: Mild to moderate systematic disturbance that may or may not be related to the reason for surgery (Stoelting and Miller, 1999) taker up for general surgeries under general anaesthesia and intubation. All the patients with the history of cardivascular, ocular and/or respiratory diseases and those who had problem of intubation or we could not intubate at the time, were excluded. The patients with range between 20 and 50 year were include. Conditions of anesthesia and drug dosage were the same for all the patients, intubation and extubation were performed by the same expert person. After premedication with fentanil 2 mg kg^{-1} of body weight, preoxygenation, induction of anesthesia with sodium thiopental 5 mg kg^{-1} of body weight and pancronium 0.1 mg kg^{-1} intravenously, after sedation and muscle relaxation. Tracheal intubation was done with machintash blade through direct laryngoscopy.

Tracheal tubes with No. 8.5 and No. 7.5 were used for males and females, respectively. After confirming of tube place, O_2 and N_2O were supplied equally; respiration was carried out with Intermittent Positive Pressure Ventilation (IPPV) with standard rate. During operation and 10 min after intubation and in case of need, halothane Minimum Alveolar Concentration (MAC), narcotic and relaxant were given after completion of operation on the correct condition (exhalation and injection of non depolarizing reverses and having regular respiratory pattern with proper numbers and extension and, calm suction of tracheal secretion) by creating positive pressure of air way by pressing bag, then extubation was performed. IOP was measured prior airway insertion and 1, 5 and 10 min after intubation and extubation. IOP values were obtained using a hand-held Schiotz tonometer by two times immediately by expert anesthesiologist and recorded in questionnaire.

Systolic and diastolic Blood Pressure (BP), Heart Rate (HR), duration of intubation at different above stages were recorded.

Statistical analysis of the changes in IOP, BP and HR were performed using t-test and paired t-test. A p value of <0.05 was considered significant.

RESULTS

In this study, 51 patients of class 1 and 2 (ASA I, II) were selected and the effects of intubation and extubation on IOP level, blood pressure and haemodynamic changes such as Heart Rate (HR), Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) were studied. Patient characteristic are summarized in Table 1. Table 2 summarizes the mean IOP results from base line prior to 1, 5 and 10 min after intubation and extubation. The IOP levels were 11.2±1.8 mm Hg and 11.68±2.18 mm Hg at prior intubation and extubation, respectively. The IOP increased significantly from pre-intubation level to 15.98±2.43, 15.14±2.26 mm Hg and 12.69±2.55 after 1, 5 and 10 min after intubation, respectively ($p<0.01$) (Table 2). IOP level was increased significantly after 1 and 5 min after extubation compare with pre-extubation but it is not significant for 10 min after extubation. It was shown that the highest IOP level was at one minute after intubation and extubation.

There were significant increasing in heart rate, systolic and diastolic blood pressure between prior and

Table 1: Demographic details of patients were entered onto in this study

Characteristic	Number or mean
Randomized (N)	51
Male	39 (77%)
Female	12 (23%)
Mean age (year)	34±11
Mean wieght (Kg)	64±12
Duration of surgery (min)	135±50
Time to complete intubation (second)*	19±8
ASA I	43
ASAII	8

* Immediately and gentely to be for extubation

Table 2: The Intraocular Pressure (IOP) before and after intubation and extubation. Values are given as mean (SD)

Time of evaluation method	Prior (mm Hg)	After 1 min (mm Hg)	After 5 min (mm Hg)	After 10 min (mm Hg)
Intubation	11.2±1.8	15.98±2.43	15.14±2.26	12.69±2.55
Extubation	11.68±2.18	16.75±2.57	14.25±2.6	12.39±2.72

Table 3: The mean of haemodynamic variables during intubation and extubation

	Intubation				Extubation			
Parameters	Pre-intubation	After 1 min	After 5 min	After 10 min	Pre-extubation	After 1 min	After 5 min	After 10 min
SBP mmHg)	111±6	145±8	128±6	118±6	113±7	130±5	115±6	112±6
DBP (mmHg)	70±5	88±6	78±5	73±5	69±5	75±6	70±5	68±4
HR (b min^{-1})	74±12	85±9	78±10	76±11	80±14	86±10	81±9	82±9

after both intubation and extubation (Table 3). The highest increase in BP and HR were at the first minute after intubation (30.6, 14.86%). The percentage of difference between increase BP and HR during intubation and extubation were significant statistically ($p<0.05$).

DISCUSSION

In this study, the IOP level increased after intubation and extubation during general surgery. The highest IOP level was observed at the first minute after intubation and extubation. The increasing of IOP level at extubation was higher than intubation. The IOP level was close to the prior intubation at 10 min after extubation, but the IOP stayed at increasing level at 10 min after intubation.

Madan *et al.* (2000) showed that IOP significantly increased at the first and second minutes after intubation and extubation in children, also they showed which increasing of IOP level after extubation is more than intubation (Madan *et al.*, 2000). The lower IOP level before intubation may be due to deep anesthesia and relaxation of the patient at intubation. Since the patients are in light unconsciousness and near to the alert condition during extubation, then irritation is more affected and leaded to more increase of IOP level (Madan *et al.*, 2000). Therefore, with the respect to increasing IOP level during extubation, the ocular damages probably increased at beginning of extubation compare with intubation. The IOP level was increased during intubation in children (Warner *et al.*, 1997). In this study we showed that IOP levels was increased during extubation compared with intubation, it is probably to be many factor affected such as removing anesthetic drugs from body, sensitive to cough, straining, breath-holding, laryngospasm and irritiation of tracheal tube extubation (Madan *et al.*, 2000). The increasing in IOP at extubation was more than at intubation in eyes, there is a greater risk of damage to vision (Madan *et al.*, 2000).

The different pulmonary and inhalation methods induced irritation and caused increase of IOP level after intubation. Eltzsching *et al.* showed the IOP level significantly increased during intubation on infants and children, it is due to higher artery blood pressure (Ehzsching *et al.*, 2001). The exact mechanism of higher IOP associated with tracheal intubation remains unknown; however, it seems to be increased sympathetic activity. The adrenergic stimulation may cause vasoconstriction and an increase in the central venous pressure, which has a closer relationship to IOP than systemic BP. In addition, adrenergic stimulation can produce an acute increase in IOP by increasing the resistance to the outflow of aqueous humor in the trabecular meshwork between the anterior chamber and Schlemm's canal (Murphy, 1985; Shribman *et al.*, 1987). Other anesthesia-related factors, such as pre medication drugs, general anesthetics and lung ventilation, are also known to affect IOP (Vinik, 1999; Murphy, 1985; Holloway, 1980).

It may be concluded that, probably, increase IOP at intubation and extubation has related to heart rate and the titer of plasma adrenaline. Whichfort *et al.* in their study showed the IOP level significantly increased up to 2 min after intubation. They did not study at extubation (Whitford *et al.*, 1997). These results were similar to our finding for increasing the IOP level and not same with regarding duration and continuation of increasing. This difference is probably related to the kind of the drugs used for induction of anesthesia in their study, because, they used propofol and atracurium, also there sample size was less than our study (13 patients). When they used Laryngeal Mask (LMA), not observed any increasing in the IOP level (Whitford *et al.*, 1997). The some drugs use for reduction on IOP in patients. Timolol and latanprost topically reduced IOP in patients. Latanprost was applied topically one daily to have a reduction in IOP of >25% (Thomas *et al.*, 2003, 2005).

Akhtar *et al.* have done the comparative study on IOP level in thirty patients under ocular operation by Laryngeal Mask (LMA) and intubation methods, they showed that induction of anesthesia propofol and proper relaxation increased the rate of IOP level, there is not difference between two methods. The laryngeal mask has not priority and the extubation complications were observed same at the end of general surgery. More frequency of coughing and sore throat were observed in the intubation compared to LMA method. Complications such as coughing, sore throat at the end of extubation were more and irritation of intubation and coughing probably caused increase of IOP (Akhtar *et al.*, 1992).

In our study, there is not observed any complication such as coughing after extubation. The coughing at the end of operation and recovery may lead to IOP and it was not observed in our study within 10 min after extubation

then the increasing level of IOP at extubation is related to other factors except coughing. Generally it is concluded that intubation and extubation lead to increase in IOP, blood pressure and pulse rate. In this way there should be prepared efficient management to prevent increasing the IOP level. Although IOP level was significantly increased but the normal intra ocular pressure is between 10 to 20 mm Hg and higher than 24 mm Hg is pathologic condition then in this our study the IOP level was at normal range and clinically is not pathologic condition (Sator *et al*., 1998; Vinik, 1999). In comparison of intubation and extubation there is needed more accurate planning to prevent increasing of above-mentioned changes at during intubation.

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