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Comparison of Intraocular Pressure and Hemodynamic Response Subsequent to Tracheal Tube versus Laryngeal Tube Insertion during General Anesthesia

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Abstract

Background: It is well accepted that intraocular pressure should be controlled during general anesthesia (G/A) for intraocular procedures. This study was performed to compare the effects of the laryngeal and tracheal tubes on intraocular pressure (IOP), mean arterial pressure (MAP) and heart rate (HR) during the course of G/A.

Methods: Eighty adult patients were randomly allocated to two groups for cataract surgery. Group A (n=40) underwent laryngeal tube (LT) placement and group B (n=40) had tracheal tube (TT) insertion. Anesthesia was induced by midazolam, fentanyl, propofol and atracurium and was maintained by propofol and 50% nitrous oxide in oxygen. IOP, MAP and HR were measured before and 3 minutes after induction of G/A, 1 and 5 minutes after tube placement, at the end of the operation, and 1 minute after extubation.

Results: The IOP at 1 minute after removal of the tubes was significantly higher in the TT group than the LT group. The MAP at 1 minute and heart rate at 1 and 5 minutes after placement of the tubes were significantly higher in TT group than the LT group.

Conclusion: In the course of G/A, using the same anesthetic agents such as propofol, and atracurium, LT had better control than TT on IOP, MAP and HR.

Keywords: Heart Rate; Intraocular pressure (IOP); Laryngeal tube; Mean Arterial Pressure; Tracheal tube

Introduction

Laryngoscopy and tracheal intubation are time-tested methods to achieve the airway control in anesthesia practice and resuscitation. However, this is associated with significant sympathetic responses in the form of hypertension and tachycardia following laryngotracheal stimulation.[1,2] Laryngoscopy and tracheal stimulation are also known to be associated with increase in intraocular pressure (IOP).[1,3] The laryngeal tube (LT) airway is an alternative to endotracheal tube (TT) for artificial ventilation of the lungs in a paralyzed patient. Insertion of LT does not require either visualization of the cords or penetration of the larynx, making the placement easier and smoother than TT and so provoking less sympathetic response and release of catecholamines. To our knowledge, this is the first study evaluating the effect of LT on IOP and hemodynamic response. So, in this prospective study, the changes in IOP, mean arterial pressure (MAP) and heart rate (HR) induced by TT were compared with those due to LT placement while propofol and atracurium were used for general anesthesia (G/A) during cataract surgery.

Materials and Methods

After approval by Local Ethics Committee and obtaining informed consent, 80 patients (American Society of Anesthesiologists Physical Status I-II), aged

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50 to 75 years were scheduled to undergo elective unilateral cataract surgery in Khalili Hospital, affiliated to Shiraz University of Medical Sciences, Shiraz, Iran. The patients were randomly divided into two groups using a closed envelope method. Patients with positive history of diabetes mellitus, hypertension, ischemic heart disease, glaucoma and previous eye operations were excluded. Similarly, those with contraindication to use either LT or TT placement, such as those with mouth opening less than 3 cm, pharyngeal pathology, and with risk of regurgitation were also excluded from this study. After arrival in operation theater, standard monitoring was started. All the patients received 0.03 mg/kg midazolam (5-Exir Broojerd, Iran), 1.5 µgr/kg fentanyl (Janssen Pharmacutica NV Turnhoutseweg 30-B-2340 Beerse, Belgium), and 1.2-1.5 mg/kg propofol (Lipuro 1% B. Braun Messenger AG 34209 Melsungen, Germany) intravenously and slowly, until loss of verbal contact. Atracurium (Tracrium Blaxo welcome SPA Via A Fleming 2 Verona, Italy) was administered (0.5 mg/kg) to provide muscle relaxation. Anesthesia was maintained by propofol (50-100 µgr/kg/min) with 50% nitrous in oxygen. The patients were mechanically ventilated by intermittent positive pressure ventilation mode with 8-10 breaths/min and a tidal volume of 10 ml/kg during the surgery without air leak to maintain normal end tidal CO2 concentration (35-45 mmHg). End tidal carbon dioxide tension was measured by a main-stream capnometer (Novametrix, California, USA).

Group A received controlled ventilation via LT (Size 3 or 4) (VBM Medisintechnik GmbH, Germany) and group B via TT (Supa Co., Iran). Three minutes before induction of anesthesia, IOP was measured in the non-operated eye using applanation tonometer (Tonopen XL, Richert, USA) after instillation of 5% tetracaine (Sina Daru, Tehran, Iran) eye drop. At the same time, HR and MAP were recorded. Measurements of IOP, MAP and HR were recorded pre-induction, 3 minutes after induction, 1 and 5 minutes after placement of either tubes, then at the end of operation, and 1 minute after removal of the tube. Statistical comparison between the two groups was performed using *t* test. A *P* value equal or less than 0.05 was considered significant. The power of study was considered 90% and the confidence interval was defined as 95%. The data analysis was performed by SPSS software, version 15.0 (Chicago, IL, USA).

Results

There was no significant difference between the two groups regarding demographic information and duration of operations (Table 1). The IOP changes are summarized in Table 2 and shown graphically in Figure 1. At 3 minutes after induction, IOP was significantly lower than that in the pre-induction time in both groups (*P*=0.05) and rose in both groups without

Table 1: Demographic data of patients and the duration of their operation (Values and a mean SD where appropriate).

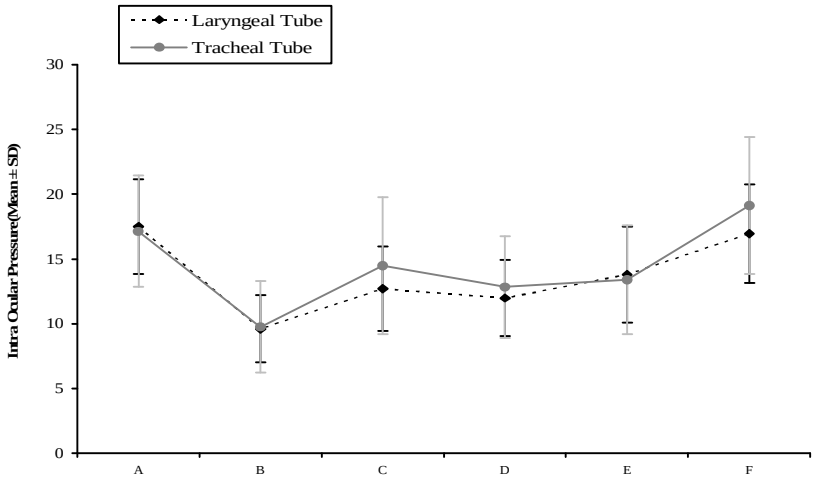
	Laryngeal tube	Tracheal tube
Weight (kg)	70 (SD=16.8)	74 (SD=13.3)
Age (year)	63.75 (SD=8.85)	67.95 (SD=6.60)
Male:Female	23:17	18:22
Duration of operation (min)	25.45 (SD=10.8)	29.97 (SD=10.17)

Both groups have almost the same data

Table 2: Mean IOP (mmHg) during G/A in TT and LT groups.

	Laryngeal tube mm Hg (SD)	Tracheal tube mm Hg (SD)	*P value*
Base line (preinduction)	17.50 (3.68)	17.13 (4.3)	0.677
3 min after induction	9.60 (2.60)	9.75 (3.53)	0.83
1 min after insertion	12.70 (3.28)	14.48 (5.30)	0.08
5 min after insertion	11.98 (2.93)	12.83 (3.92)	0.28
End of operation	13.8 (3.71)	13.40 (4.22)	0.65
1 min after extubation	16.95 (3.81)	19.13 (5.30)	0.04

IOP decreases during G/A course but increases after extubation



IOP decreases more in LT group during general anesthesia
A: Preinduction B: 3 minutes after induction C: 1 minute after insertion
D: 5 minute after insertion E: End of operation F: 1 minute after removal

Fig 1: Mean (SD) percentage change in intra-ocular pressure with tracheal tube and laryngeal tube airway.

any significant difference (*P*=0.83) later on. At 1 minute after removal of the tube, although IOP increased in both groups (Table 2), it was significantly higher in the TT group (*P*=0.04). At this stage, in the TT group, IOP was even higher than the pre-induction value (*P*=0.03). The data were analyzed by independent sample and paired tests. Changes in the mean arterial pressure and heart rate are shown in Table 3, Figure 2 and 3.

At 3 minutes after induction, MAP and HR were significantly less than the pre-induction value (*P*=0.05). MAP at 1 minute (*P*=0.001) and HR at 1 and 5 minutes (*P*=0.001 and *P*=0.01, respectively) after placement of the tubes were significantly higher in the TT group than the LT group. MAP decreased during the course of anesthesia in both groups; at 1 minute after extubation, MAP was the same as pre-induction value (*P*=0.99) in LT, but it was higher in TT group (*P*=0.17). HR, although lower than pre-induction value during G/A, increased above the pre-induction period in both groups without any significant difference (*P*=0.89) at 1 minute after extubation.

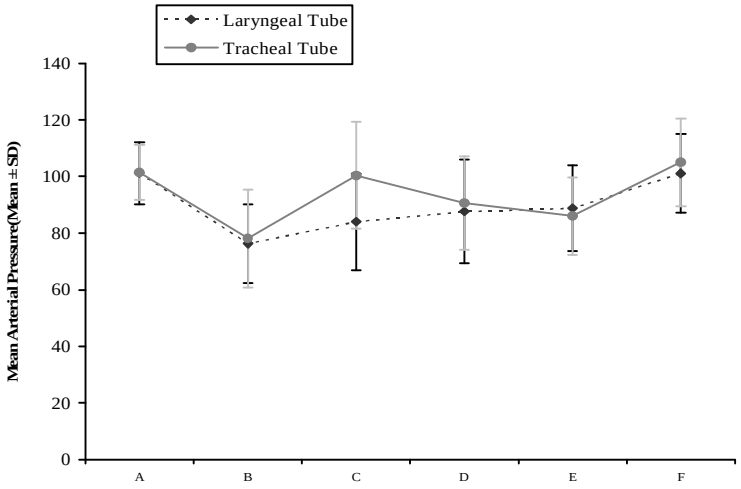
Discussion

G/A is electively used by ophthalmologists for different ocular surgeries and it is the best choice in operation of eyes with perforating ocular trauma, suspected penetrating injuries or glaucoma. The usual method is to use laryngoscope and endotracheal tube which can stimulate the larynx and/or trachea. This local stimulation can lead to sympatho–adrenal discharge (stress response) and then a rise in IOP, HR and MAP.[1,2] Vaso- and venoconstriction due to adrenalin discharge cause increased central venous pressure[1,3,4] and resistance in trabecular meshwork of the eyes[5] that leads to an increase in IOP. The use of anesthetizing

Table 3: MAP (mmHg) and HR (beat/min) during G/A in LT and TT groups. Values are expressed as mean SD.

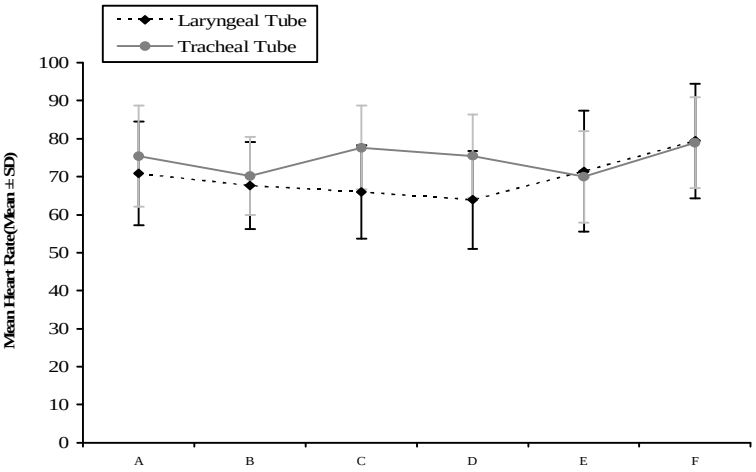
				HR		
	L-T	**T-T**	**P value**	**L-T**	**T-T**	***P value***
Base line	101.1 (11.03)	101.50 (9.65)	0.89	70.85 (13.59)	75.38 (13.31)	0.14
3 min after induction	76.28 (13.79)	78.13 (17.30)	0.59	67.68 (11.43)	70.18 (10.25)	0.31
1 min after insertion	83.98 (17.08)	100.45 (18.94)	0.001	65.97 (12.29)	77.65 (11.05)	0.001
5 min after insertion	87.63 (18.28)	90.68 (16.47)	0.44	63.90 (12.85)	70.50 (10.94)	0.02
End of operation	88.75 (15.12)	86.00 (13.74)	0.39	71.45 (15.96)	69.97 (12.03)	0.64
1 min after extubation	101.15 (13.83)	105.00 (15.57)	0.25	79.40 (15.04)	79.00 (11.95)	0.89

MAP decrases during G/A in both groups but more significantly in LT groups. HR decreased in both groups, more significantly in early episodes in LT group, and increased after extubation.



MAP decreases in both groups although more significant in LT group
A: Preinduction B: 3 minutes after induction C: 1 minute after insertion
D: 5 minute after insertion E: End of operation F: 1 minute after removal

Fig 2: Mean (SD) percentage change in mean arterial pressure with tracheal tube and laryngeal tube airway.



HR decreases during G/A, more significantly in LT group
A: Preinduction B: 3 minutes after induction C: 1 minute after insertion
D: 5 minute after insertion E: End of operation F: 1 minute after removal

Fig 3: Heart rate changes in laryngeal and tracheal tube groups.

agents like propofol was shown to cause about 30% drop in IOP in regard to baseline but stress of endotracheal intubation caused a rise in IOP, although the value was below the baseline.[6] So, hemodynamic and IOP changes need to be controlled in some ways, using, for example, laryngeal mask airway (LMA) instead of tracheal tube, to have less sympathoadrenalin discharge. Holden et al.,[7] Lamb et al.[8] and Whitford et al.[9] showed that LMA at the time of placement and removal caused less change than endotracheal tube on IOP. In our study, similarly, after induction, both groups showed decreased IOP value in respect to baseline. One minute after intubation, again IOP increased to a lower level than baseline in both groups although it was more in TT group (*P*=0.08). One minute after extubation, TT group had IOP higher than LT group and even above the baseline (*P*=0.03), which can be problem causing in eye

surgeries especially in traumatically lacerated eyes and glaucomatous eyes. MAP declined in both groups (P=0.59) 3 minutes after induction in respect to baseline (P=0.001). During G/A, MAP was lower than baseline in all patients, but 1 minute after tube insertion TT group had a MAP higher than LT group (P=0.001). After extubation, TT group showed higher MAP but it was not significant (P=0.25) in regard to LT group or baseline (P=0.17). In other words, both techniques had well controlled MAP during G/A course. HR was lower than baseline level in LT group but higher than baseline in TT group at 1 minute after tube insertion. At 1 and 5 minutes after tube placement, TT group had, significantly, higher HR than LT group (P=0.00 and P=0.01, respectively). At 1 minute after airway extubation, both groups showed increased HR (P=0.89); this increment was significant in the laryngeal tube group (P=0.02) in comparison with baseline value but not significant in the tracheal tube group (P=0.06). This shows that HR is better controlled in LT group during G/A, but after extubation it increased in both groups and more significantly in LT group.

Finally, we can conclude that IOP changes are the same during surgery but significantly lower in LT group after extubation. However, MAP and HR changed similarly in either group.

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Conflict of interest: None declared.

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