Comparative study between laryngeal mask airway and endotracheal tube as regard the effect on intraocular pressure and hemodynamic response in pediatrics undergoing congenital glaucoma surgery

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Abstract

Background: This study aims to compare both endotracheal (ETT) tube and laryngeal mask airway (LMA) as a conduit for continuous ventilation during general anaesthesia as regard their effect on the hemodynamic response and intraocular pressure (IOP) after their insertion intra operative in pediatric patients undergoing congenital glaucoma surgery.

Methods:Patients were divided into two groups of 25 patients each. Group I; patients who were subjected to LMA insertion group II ;patients who were subjected to conventional laryngoscopy and endotracheal intubation .

Results:The result of our study demonstrated that there was high significant differences between LMA insertion and endotracheal intubation as regard hemodynamic responses; Heart rate increased after insertion of ETT in (group II), HR (p value <0.05) and continued until 2 min after insertion. Also, there was a significant difference in the mean blood pressure after insertion in ETT group (p value <0.05), BP continued to be elevated until 3 min after insertion. As regard IOP in our study, we noted that there was no difference between two group at base line but there was a significant increase in the intraocular pressure after insertion in ETT group when compared with LMA group (p value<0.05), and continued until 3 min after insertion then regressing without significant difference between both groups all over the procedure, after removal of both devices ,there was increase in IOP measurement in both groups but the increase was insignificantly different between both groups (p value >0.05) . As regard complications, in our study fewer complications occurred after removal of both devices ; as coughing in two cases (8%) in LMA group compared with six cases (28%) in ETT group, two cases (2%) had straining in LMA group compared with seven cases (28%) in ETT group ,one case (4%) had laryngospasm in ETT group with no significant difference between the two groups (p. value>0.05), also we noticed that complications as airways trauma, aspiration and gas leakage didn't occur.

Conclusion:Laryngeal Mask Airway was better than endotracheal intubation when used as a conduit for airway management; it had less hemodynamic responses and changes in the IOP.

Introduction

Airway management is the most important part during delivery of general anaesthesia.[1] Patients who have been anaesthetized are unable to maintain an adequate airway on their own so that artificial airway

maintenance devices are employed.[5] The endotracheal tube is the gold standard method for maintaining patent airway during anaesthesia because of near complete protection from aspiration.[7] However, laryngoscopy and intubation has been associated with significant cardiovascular responses in the form of tachycardia, hypertension and an increase in intraocular pressure Among various techniques to attenuate this response was a new concept of use of laryngeal mask airway (LMA) for airway access.[3] The laryngeal mask airway was introduced by Brain A.I.J in 1983.Although it does not offer airway protection against foreign material in the pharynx but provides adequate airway control to allow intermittent positive pressure ventilation. Tracheal intubation is associated with pressor response, breath holding, coughing and also leads to an increase in intraocular pressure. Use of LMA causes less coughing, straining and breath holding.[4] The use of LMA is recommended as a mean of avoiding the hemodynamic responses especially to tracheal intubation in circumstances where such a response might be undesirable.[10]

Patients and Methods

After approval of ethical committee, in Sohag university hospital, fifty pediatric patients aged 3 months-10years with ASA grade I-II scheduled to undergoing congenital glaucoma surgery under general anaesthesia were enrolled in the study after obtaining informed written consent from patient's parents. we exclude the patient with cardiovascular problems. Patients with upper respiratory tract infection. Predicted difficult intubation patients. Full stomach patients. Patients with other congenital anomalies. Patients with previous surgically corrected congenital glaucoma in the measured eye. Patients were divided into two groups of 25 patients each.

group I; patients who were subjected to LMA insertion group II ;patients who were subjected to conventional laryngoscopy and endotracheal intubation .

After arrival to the operative room ,patients pre oxygenated with 100% oxygen ,induction of anesthesia done by sevoflourane at three times MAC which is 2% ,then IV line inserted, atropine was given intravenous at dose ,01 - ,02mg/kg ,analgesia was achieved by fentanyl 2 microgram /kg intravenous also neuromuscular paralysis is achieved by Rocruronium 0.5 mg /kg intravenous .Standard monitoring was done for all cases in the form of pulse oximetry ,non invasive blood pressure ,electrocardiogram and capnography .Intraocular pressure was measured in the none operative eye by ophthalmic surgeon using applanation tonometer after instillation of 4% topical lignocaine.Patients maintained on oxygen, sevoflourane at its MAC 2 % and Rocruronium shots every half an hour 0,15 mg /kg with positive pressure ventilation. At the end of the surgery, an eye bandage was done. Removal of LMA or extubation was done only after satisfactory establishment of spontaneous breathing and we should note that extubation or removal of LMA is done in deeply sedated patients.Data collected as:Demographic dataAge, sex, height, weight and duration of surgery. Haemodynamics (HR-BP)-Base line before induction- Immediately after intubation or insertion of LMA- 2 minutes- 3 minutes- Every 10 minutes till end of surgery- 5 minutes after extubation or LMA removal Intraocular pressure (IOP)- Base line after induction-Immediately after intubation or LMA insertion 2 minutes- 3 minutes- 5 minutes- 5

minutes after extubation or LMA removal,complications (side effects)-Airway trauma-Gastrointestinal aspiration-Gas leak- Coughing-Straining-Post extubation or LMA removal laryngeal spasmStatistical analysis,The data obtained were analyzed using statistical program for social science (SPSS).All parametric data (continuous or discreet) obtained from age ,and hemodynamics variations were analyzed using student t-test .Evaluation of none parametric data (nominal or ordinal) were analyzed using Chi square test . P-Value < 0.05 was considered significant.

Results

Demographic data:

	LMA	ETT
Age (months)	6±4	4±2
Sex (male/female)	12:13	10:15
Ht (cm)	40±5	45±2
WT(kg)	15±6	12±4
Duration of surgery(mint)	55±5	60±4

(Table 1): demographic data.
Data presented as mean ±standard deviation.
Demographic data comparable between two group with no significant differences (p value >0.05).

Comparison between LMA and ETT regarding heart rate:

	IMA	ETT	P value
HR at baseline	**116.96±9.973**	**117.16±10.250**	**0.945**
HRimm after inser	**132.00±10.336**	**141.52±9.798**	**0.002**
2 minutes	**131.88±10.227**	**141.32±9.886**	**0.002**
3 minutes	**123.56±9.730**	**128.92±9.354**	**0.053**
10 minute	**117.52±9.900**	**118.32±10.209**	**0.780**
20 minute	**117.16±9.694**	**117.68±10.107**	**0.853**
30 minute	**117.04±9.637**	**117.20±10.288**	**0.955**
40 minute	**117.16±9.907**	**117.24±10.175**	**0.978**
50 minute	**116.96±9.727**	**117.00±10.104**	**0.989**
60 minute	**116.92±9.691**	**117.00±10.206**	**0.977**
5 minute after removal	**119.60±9.908**	**121.36±10.531**	**0.546**

Table (2): Comparison between LMA and ETT regarding heart rate
Data presented as mean ±standard deviation .

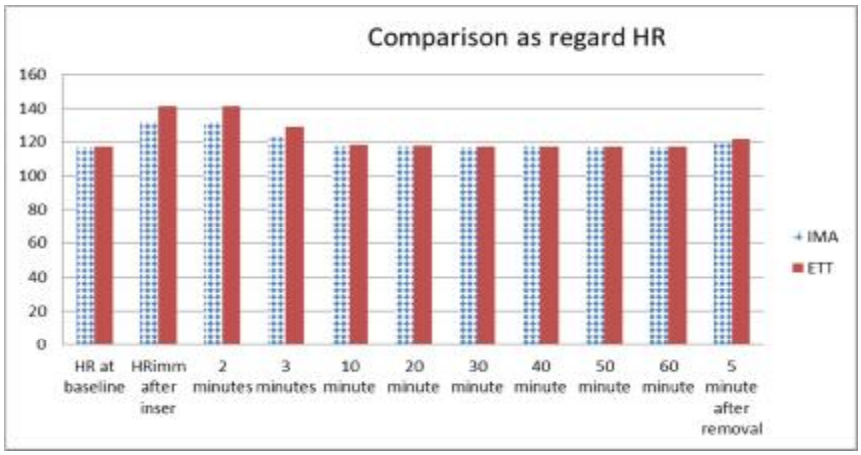

Figure (1): Comparison between LMA and ETT regarding heart rate

Comparison between LMA and ETT regarding mean blood pressure:

	LMA	ETT	P. VALUE
BPat baseline	55.28±5.192	55.32±5.113	0.978
BPimm after insertion	65.48±6.049	76.36±5.353	0.001
2 minutes	65.44±6.001	76.32±5.352	0.001
3 minutes	59.16±5.640	65.24±5.854	0.001
10 minute	55.00±5.362	55.52±4.942	0.723
20 minute	54.72±5.176	55.16±4.810	0.757
30 minute	54.76±5.158	55.08±4.760	0.821
40 minute	54.68±5.297	55.08±4.830	0.871
50 minute	54.64±5.291	55.04±4.817	0.781
60 minute	54.60±5.252	55.00±4.796	0.780
5 minute after removal	56.72±5.103	59.16±5.610	0.114

Table (3): Comparison between LMA and ETT regarding mean blood pressureData presented as mean ±standard deviation .

Comparison between LMA and ETT regarding IOP:

	LMA	ETT	P.VALUE
IOP at baseline	28.84±7.122	28.88±7.114	0.984
IOP imm after insertion	31.04±7.214	39.96±6.717	0.001
2 minutes	30.80±7.124	38.80±6.468	0.001
3 minutes	29.20±7.065	32.72±6.779	0.079
5 minute	28.52±7.072	28.72±7.039	0.921
IOP after removal	29.28±7.608	31.48±7.315	0.3

Table (4): Comparison between LMA and ETT regarding IOP Data presented as mean ±standard deviation.

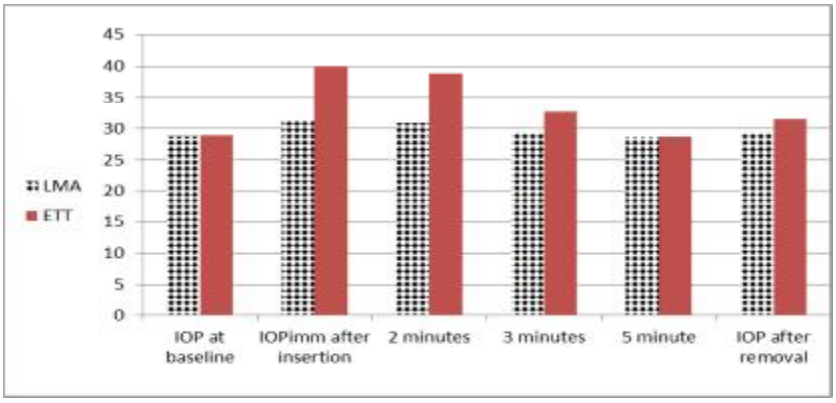

Figure (3): Comparison between LMA and ETT regarding IOP

Comparison between LMA and ETT regarding complications:

	LMA	ETT	P.value
Airway trauma	0	0	-
aspiration	0	0	-
Gas leak	0	0	-
coughing	2(8%)	6(24%)	0.247
straining	2(8%)	7(28%)	0.06
Laryngospasm	0	1(4%)	0.312

Table (5): Comparison between LMA and ETT regarding complications

Data presented as no. of cases and percentage.

Discussion

Airway management is the most important maneuver during delivery of general anaesthesia. Patients who have been anaesthetized are unable to maintain an adequate airway patency so that artificial airway maintenance devices are employed (Alan et al., 2001).

The endotracheal tube is the gold standard method for maintaining patent airway during anaesthesia because of near complete protection against aspiration (Alan et al., 2001).

However, laryngoscopy and intubation has been associated with significant cardiovascular responses in the form of tachycardia and hypertension (Forbes et al., 1970) and an increase in the intraocular pressure (Watcha et al., 1992). Among various techniques to attenuate these responses was a new concept of the use of laryngeal mask airway (LMA) for airway access.

The laryngeal mask airway was introduced by Brain A.I.J in 1983.Although it does not offer airway protection against foreign material in the pharynx but provides adequate airway control to allow intermittent positive pressure ventilation (Brain et al., 1983).The use of LMA is recommended as a mean of avoiding the hemodynamic responses especially to tracheal intubation in circumstances where such responses might be harmful (Wood,. 1994).

This study aims to compare between the endotracheal tube (ETT) and the

laryngeal mask airway (LMA) as a conduit for continuous ventilation during general anaesthesia as regard their effects on the hemodynamic response and intraocular pressure (IOP) after their insertion in pediatric patients undergoing congenital glaucoma corrective surgery.

Our study included two groups (group I)&(group II), each group consist of 25 patient; (group I) patients who were subjected to LMA insertion, (group II) patients who were subjected to conventional laryngoscopy and endotracheal intubation.Patient demographic data were comparable between both groups and there were no significant differences between the two groups regarding gender of the patients, mean age of the study groups, weight, height and the duration of surgery.

In our study there, was high significant differences between LMA insertion and endotracheal intubation as regard hemodynamic responsesOur results come in contact with a study done by Sangeeta et al; (2016), this prospective comparative trial was undertaken to compare the effects of insertion of ProSeal LMA and Endotracheal tube on haemodynamic responses, in pediatrics patients undergoing lower abdominal surgeries under general anaesthesia and requiring positive pressure ventilation. Both ETT and PLMA cause increase in hemodynamic responses, but the magnitude and duration of response is less in LMA.

Also, similarly to our results, study of QASI et al; (2013) have reported the advantages of Flexi laryngeal mask airway (FlexiLMA) over endotracheal intubation in minimizing the pressor response in pediatric patients undergoing ophthalmic operations. Changes in heart rate, mean arterial pressure were noted at different intervals which were markedly different between both groups. There was a rise of these parameters compared to the baseline values within the two groups. This rise was maximum at 1 minute after insertion/ intubation and remained high at 2nd minute after insertion/ intubation then came down to near baseline at the end of 3rd minute. The rise of the parameters in the endotracheal group was much higher than that in the LMA group (p value <0.05).

Our results coincide with a study done by lalwani et al; (2010) that compared the efficacy of ProSeal LMA with an endotracheal tube in pediatric patients as regard haemodynamic responses. Haemodynamic responses were significantly higher (*P* value<0.05) after endotracheal intubation as compared to the placement of PLMA. The mean pulse rate (bpm) increased from a baseline value of (103.70±11.56) to (109.50±12.41) and from (102.46±11.46) to (122.83±8.30) after the placement of PLMA and the endotracheal intubation respectively. The increase in the pulse rate was statistically significant (*P value* <0.05) in both groups before 10 minutes. The increase in the pulse rate was statistically significant(*P* value <0.05) even after 10 min of endotracheal intubation (Group B).

Also our results come in contact with the previous study done by GULATI et al; (2004) to compare the use of endotracheal tube and LMA in pediatrics undergoing ophthalmic surgeries as regard haemodynamic responses, IOP changes and postoperative complications .The study demonstrated that insertion of the airway device was associated with significantly greater change in HR in the endotracheal tube group compared with the LMA group, Also statistically significant change in MAP was observed between the two groups at the measured time points.

Our results supported by WATCHA et al ;(1992), who made a study to compare the IOP and hemodynamic responses to the insertion of an LMA or tracheal tube during strabismus surgery in pediatric patients. Immediately after tracheal intubation, there was a significant increase in HR and mean arterial pressures above baseline values and the corresponding values in the LMA group. In the ETT group, HR remained significantly higher than baseline values for 4 min after tracheal intubation, whereas systolic, diastolic, and mean arterial blood pressures returned to baseline values after 3, 2, and 3 min, respectively. In contrast, there were no significant differences in HR, systolic, diastolic, and mean arterial pressures compared with baseline values in the LMA group.

In contrast to our study, AKHTAR et al ;(1992), have reported that changes in heart rate and mean arterial pressure after the insertion of the laryngeal mask airway or the tracheal tube were not significantly different. In that study both vocal cords were sprayed with lignocaine 4 % before tracheal intubation, this may play a role in the attenuated haemodynamic response to endotracheal intubation, also we believe that the attenuated increase in the MAP in that study may be due to induction of anaesthesia with propofol 1%. Intravenous propofol induction has been shown to cause a 30% decrease In the MAP pressure from baseline that might mask the increase in MAP caused by ETT stimulation. While in our study induction of anaesthesia was done by sevoflurane 6%, which has gained popularity in pediatric anaesthesia since its introduction into clinical practice, because of its rapid induction together with its advantages on cardiovascular stability.

Also, In contrast to our study ATES et al ;(2001)had studied the effects of sevoflurane on intraocular pressure after induction in children undergoing either endotracheal tube (ETT)or laryngeal mask airway (LMA) insertion without the use of muscle relaxant; the study included 38 children. Anaesthesia was induced with sevoflurane (8%) and maintained with (3±4%) sevoflurane in 100% O2. ETT was inserted in (group I) and an LMA in (group II). The heart rate, mean arterial pressures were recorded after induction, insertion of ETT or LMA and at 1, 2 and 3 min. They noticed that the MAP decreased after induction in both groups (P value <0.01). In (group I), MAP increased significantly after ETT insertion and remained high for 1 min (P value <0.01). In (group II), MAP also increased significantly after LMA (P value <0.01). MAP measurements between the two groups were not statistically significant (P value >0.05). Although, they used higher concentration of sevoflurane for induction and maintenance than our study, Lack of muscle relaxation usage may explain their results compared to our results.

As regard IOP in our study, we noticed that there was no significant difference between both groups at base line but there was a significant increase in the intraocular pressure after insertion in ETT group when compared with LMA group (p value<0.05), and continued until 3 min after insertion then regressing without significant difference between both groups all over the procedure, after removal of both devices ,there was an increase in IOP measurement in both groups but the increase was insignificantly different between both groups (p value >0.05) .

Our results come in agreement with a study done by QASI et al; (2013) who

have reported the advantages of Flexi laryngeal mask airway (FlexiLMA) over endotracheal intubation in minimizing the rise in the IOP in pediatric patients undergoing ophthalmic operations, Regarding the changes in the intraocular pressure, the rise just after intubation was statistically significant which declined to almost its baseline value subsequently, This rise was much higher in the endotracheal group than LMA group (p value <0.05).

Similarly to our results GULATI et al; (2004), have reported that, the mean intraocular pressure did not change significantly with the insertion of the LMA (group1), but LMA removal significantly increased the mean Intraocular pressure over base line value. Endotracheal intubation (group2) was followed by a significant increase in the intraocular pressure and extubation caused a further rise which was also statistically significant. Changes in the intraocular pressure between specific time points were measured and values were compared between both groups. IOP changes were significantly higher at all-time points in the endotracheal tube group compared with the LMA group.

In a study done by WATCHA et al ; (1992) to compare the IOP and hemodynamic responses to the insertion of an LMA or tracheal tube during strabismus surgery in pediatric patients. As regard IOP; baseline measurements of IOP was recorded and repeated within 15-30 seconds after insertion of the airway device and at one min intervals for 5 min. The LMA insertion didn't increase IOP above baseline values. In contrast, tracheal intubation was associated with significant increase of IOP.

In contrast to our study AKHTAR et al ;(1992), have reported that changes in IOP after the insertion of the laryngeal mask airway or endotracheal tube were not significantly different, IOP values didn't change in both groups compared to the base line values. This may be due to spraying of both vocal cords with lignocaine 4% before intubation which might attenuate bucking, straining and coughing reflexes which respectively decrease the rise in intraocular pressure in response to intubation.

Also, our findings came in contrast with ATES et al ;(2001) who made a study about the effects of sevoflurane on intraocular pressure after induction in pediatrics undergoing either endotracheal tube (ETT) or laryngeal mask airway (LMA) insertion without a muscle relaxant, Intraocular pressures increased significantly in group I after ETT and remained high until 3 min (P value <0.05). The IOP were not changed in (group II) at all measurements. There was no statistically significant difference between the IOP values in the two groups at any time of measurement (P value >0.05).

In our study, we noticed that removal of LMA and endotracheal extubation didn't cause significant difference in the haemodynamic responses (HR, BP) and IOP changes.

In contrast to our study, FUJII et al ;(1998),reported that The maximal changes in HR, SBP and DBP were less in LMA group than in ETT group during the observation period (HR; 12 vs 26), (SBP; 14 vs 28), (DBP; 9 vs 13), (P value < 0.05). Laryngeal mask airway removal elicited less haemodynamic changes than tracheal extubation in pediatric patients.

Also, Sangeeta et al (2016), have reported that there was an increase in the HR, MAP and IOP during ETT extubation than the increase of these parameters after removal of LMA (p value <0.05).

GULATI et al; (2004), found that no changes in hemodynamic parameters,

but the mean maximum rise in the IOP was greater in the endotracheal tube group than the LMA in response to removal of the airway device.

As regard complications, in our study fewer complications occurred after removal of both devices ; as coughing in two cases (8%) in LMA group compared with six cases (28%) in ETT group, two cases (2%) had straining in LMA group compared with seven cases (28%) in ETT group ,one case (4%) had laryngospasm in ETT group with no significant difference between the two groups (p. value>0.05), also we noticed that complications as airways trauma, aspiration and gas leakage didn't occur.

Our results come in agreement with Sangeeta et al; (2016), In the PLMA group, 2 patients coughed after removal while in the ETT group, 4 patients coughed. This was statistically insignificant (P value >0.05) .

Results of GULATI et al; (2004) were similar to our results;the total number of complications as coughing and laryngeal spasm was not significantly different between both groups, (p value >0.05).

In contrast to our findings, QASI et al; (2013) had reported that statistically significant number of patients experienced coughing after extubation in group II (ETT group), compared to Group I patients (pLMA group) (p value <0.05).

Also, in contrast to our study lalwani et al; (2010) found thatthere was a significant incidence of cough in group B (ETT group) (30%) patients after extubation as compared with the group A (PLMA group) (6.6%) patient (*P* value<0.05). Bronchospasm was seen in two (6.6%) patients after extubation in group B but none of the patients had bronchospasm in the group A after removal of PLMA. After removal of PLMA (Group A), airway trauma was noted in six (20%) cases but only two (6.6%) cases had airway trauma after ETT extubation (Group B).

Previous studies, Sangeeta et al; (2016), Gulati et al; (2004) and Lalwani et al; (2010), commented on the incidence of some other complications like sore throat, hoarseness of voice and breath holding. Children's in our study may be less able or less likely to complain about sore throat, breath holding compared to older children in the previous studies. Also the use of uncuffed endotracheal tubes in our study, as a routine practice in pediatric anaesthesia, may have contributed to the absence of that complications, plus extubation or removal of the devices in a deep level anaesthesia.

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