Ann Anesth Crit Care . 2018 April; 3(1):e11701. doi: 10.5812/aacc.11701.

Published online 2018 July 22. **Research Article**

Hemodynamic Changes After Intubation of Endotracheal Tube, LMA Classic™, and I-gel in Patients Candidates for Elective Eye Surgery

Reza Akhondzadeh[1,*], Salman Vojdani[1] and Seyed Mehdi Aslani[1]

[1]Department of Anesthesiology, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran

[*]*Corresponding author*: Associate Professor, Department of Anesthesiology, Pain Research Center, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran. Tel: +98-6112220168, Email: rezaakhoundzadeh@gmail.com

Received 2017 April 10; **Revised** 2018 January 27; **Accepted** 2018 April 10.

Abstract

Background: One of the concerns of the anesthetists in performing surgical procedures is hemodynamic changes after laryngoscopy and tracheal tube intubation. In these cases, stress response with the release of catecholamines leads to increased blood pressure and heart rate in patients who are prone to cardiovascular disease and cerebral events, leading to the life-threatening risks.
Objectives: Endotracheal Intubation (ETT) is one of the most stress response techniques for airway management. Here, we compare the effects of tree devices including ETT, laryngeal mask airway (LMA) classic, and I-gel with each other.
Methods: The present study investigated the hemodynamic changes in patients undergoing elective cataract surgery after the intubation of an endotracheal tube. This clinical trial study was conducted on 75 patients with ASA class I or II in both genders and in the age group of 50 - 65 years old. The effects of LMA Classic™ and I-gel were also investigated. In this study, patients' vital signs such as pulse rate, systolic blood pressure, and diastolic blood pressure were measured and recorded at times before insertion of the airway devices, one, two, and five minutes after the insertion.
Results and Conclusions: Before the start of the operation, there was no significant difference between the groups in terms of hemodynamic parameters. Immediately before inserting ETT, LMA, or I-gel, the heart rate and systolic and diastolic blood pressure increased significantly in all groups. Our results generally showed that the hemodynamic changes due to the I-gel insertion compared to the tracheal tube and LMA Classic™ insertion followed minor adjustments. In a comparison between the insertion of the endotracheal tube and LMA Classic™, the use of the LMA Classic™ was associated with more stability.

Keywords: Cataract Surgery, ETT, Hemodynamic Response, I-gel, LMA

1. Background

Hemodynamic changes following laryngoscopy and intubation of tracheal tube are one of the concerns of anesthetists in performing surgical procedures. In these cases, the stress response with the release of catecholamines leads to increased blood pressure and heart rate, which can lead to life - threatening risks in the patients susceptible to cardiovascular diseases and cerebral events. Several methods have been used to avoid the stress response and to prevent hemodynamic changes (1-3).

One of these methods is the use of *supraglottic* devices that are designed for the lower stimulation and prevention of injuries caused by the tracheal intubation to the soft tissues, teeth, and vocal cords (4-6). It seems that due to the non-placement of laryngeal mask airway (LMA) (Figure 1) within the trachea and less irritation caused, the complications of the procedure of endotracheal intubation are less (7-9).

I-gel (Figure 2) is a supraglottic device. It is the innovative second - generation supraglottic airway device from Intersurgical made of thermoplastic elastomer and has an acceptable hardness (soft) and a loose mode like without inflating the cuff. It is anatomically designed so that it is well equipped on the perilaryngeal and hypopharyngeal structures. We can point out to some of its benefits such as ease of insertion, less tissue damage, lack of movement caused by the inflating cuff, the simplicity of the structure, and reduction of costs (10, 11). In this way, there is no need for laryngoscopy to see the vocal cords; also, the laryngeal mask is not instead into the trachea, and instead, it is placed in the hypopharynx. These factors cause less stress to the patient and therefore better control of patients' hemodynamic responses (12).

Copyright © 2018, Iranian Society of Anesthesiology and Critical Care. This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (http://creativecommons.org/licenses/by-nc/4.0/) which permits copy and redistribute the material just in noncommercial usages, provided the original work is properly cited.

Figure 1. LMA classic.

Figure 2. I-gel.

2. Objectives

This study investigated hemodynamic changes and intraocular pressure in patients undergoing elective cataract surgery after the intubation of an endotracheal tube, LMA, and I-gel.

3. Methods

After the permission of the ethics committee (Ajums.REC.1392.292.) and Pain Research Center of Ahvaz Jundishapur University of Medical Sciences, this clinical trial study was conducted on 75 patients with ASA class I and II in both genders and in the age group of 50 - 65 years old, referring to Imam Khomeini hospital in Ahvaz for elective eye surgery. Inclusion criteria included patients NPO, candidates for elective eye surgery, ASA I or II, and with no contraindication for the use of SGAs. Exclusion criteria included patients with any history of gastroesophageal reflux, patients with strabismus, and patients who failed to use the airway devices in the first effort, as well as patients with a BMI higher than 25, and the duration of the surgery higher than 90 minutes. After transferring the patient to the operating room, patients' height and weight were measured. Then, the patient underwent routine monitoring, including ECG, pulse oximetry and systolic and diastolic blood pressure and after the establishment of the venous way, 5 cc per kg of 9.0% normal saline solution was administered. The patients were pre-oxygenated with spontaneous breathing for three minutes, and up to the loss of the eyelid reflex, they were under general anesthesia with the use of the following drugs: midazolam 0.02 mg/kg, fentanyl 1.5 μg/kg, and propofol 1 mg/kg. Then, atracurium 0.5 mg/kg was used and after three minutes, airway devices were used. The used LMA was from Teleflex Silicon based on the weight and sex of patients, and endotracheal tube used was PVC from a manufacturing company (SUPA LMA) that was inserted by an anesthesia assistant with a method similar to the tracheal tube intubation and I-gel. To maintain the anesthesia, propofol infusion at a dose of 50 μg/kg/min, oxygen and N_2O 50% and a flow equal to 4 liters were used. Cuff pressure in the *LMA Classic*™ reached by a manometer to 60 cm H_2O and in the endotracheal tube to 25 cm H_2O. Vital signs were recorded by the manufacturer of Reichert and at times of one minute before inserting airway devices, one, two, and five minutes after the insertion.

3.1. Statistical Analysis

One Way - ANOVA was used for between - group comparisons and the post hoc Bonferroni test was used for measuring significant differences. A P value of 0.05 was considered as the significance level and all statistical analyses were performed with the use of SPSS version 16.

4. Results

With regard to age and weight (Table 1), the groups were compared with each other. Before the start of the operation, there was no significant difference between the groups in terms of hemodynamic parameters ($P < 0.05$; Table 2). Immediately before inserting ETT, LMA, or I-gel, the heart rate, systolic and diastolic blood pressure, and intraocular pressure increased significantly in all groups ($P < 0.01$; Table 2). Heart rate and systolic blood pressure one minute after inserting airway devices remain high significantly ($P < 0.01$; Table 2). The increase in heart rate was significantly higher in ETT (endotracheal intubation) than in the I-gel group. In addition, systolic and diastolic blood pressure was significantly higher in ETT LMA and I-gel groups and a significant difference was observed between the two groups of LMA and I-gel ($P < 0.01$; Table 2). Two minutes after inserting, hemodynamic changes and intraocular pressure were still higher in the ETT group than in the LMA and I-gel groups ($P < 0.01$; Table 2). Five minutes after inserting, heart rate was higher in the ETT group than in the LMA and I-gel groups and systolic blood pressure was lower in the I-gel group compared to the ETT and LMA groups ($P < 0.01$; Table 2). Our results generally showed that the hemodynamic changes followed only minor adjustments when using the I-gel compared to the tracheal tube and LMA. In a comparison between the endotracheal tube and the LMA, the use of the LMA was associated with more stability.

Table 1. Demographic Data of the Three Groups[a]

Group	Number of Samples	Age (y), Mean ± SD	Weight (kg), Mean ± SD	Gender	
				Female	Male
ETT	33	59.5 ± 2.41	73.04 ± 6.71	9	24
LMA	33	58.6 ± 17.08	71.29 ± 8.56	12	21
I-gel	33	58.5 ± 93.71	73.79 ± 8.08	10	23

[a]The alpha significance is considered at a level of $P < 0.05$; no significant difference was observed between the groups.

Table 2. Hemodynamic Changes in Groups at Different Stages[a]

Variable and Group	Resting	One Minute Before Inserting	One Minute After Inserting	Two Minutes After Insertion	Five Minutes After Insertion
Heart rate (beats per minute)					
ETT	76.68 ± 5.64	88.8 ± 23.17[b]	105.11 ± 61.02[b, c]	100.10 ± 3.58[b, c, d]	90.11 ± 36.83[b, c, d]
LMA	76.59 ± 7.02	87.9 ± 71.15[b]	95.10 ± 37.17[b]	84.12 ± 36.23	82.11 ± 10.73
I-gel	7.23 ± 7.71	85.9 ± 92.01[b]	90.11 ± 22.11[b]	80.11 ± 23.54	78.12 ± 18.84
Systolic blood pressure (mmHg)					
ETT	135.7 ± 7.02	105.7 ± 31.67[b]	155.6 ± 71.54[b, c, d]	138.7 ± 65.36[c, d]	126.7 ± 22.21[c]
LMA	4.15 ± 91.130	103.6 ± 73.41[b]	111.6 ± 65.81[b]	107.6 ± 44.91	118.6 ± 90.62[c]
I-gel	132.6 ± 41.35	100.6 ± 87.37[b]	105.7 ± 4.59[b]	103.6 ± 71.23	105.7 ± 61.63
Diastolic blood pressure (mmHg)					
ETT	84.31 ± 6.61	66.7 ± 39.05[b]	98.7 ± 84.35[b, c, d]	90.6 ± 35.22[c, d]	85.8 ± 38.15
LMA	80.43 ± 6.12	64.6 ± 2529[b]	76.6 ± 73.92	72.7 ± 43.24	82.7 ± 34.33
I-gel	82.5 ± 72.47	67.5 ± 40.75[b]	74.7 ± 39.15	70.7 ± 39.05	80.8 ± 45.41

[a]The alpha significance is considered at $P < 0.05$.
[b]Significant difference compared to the rest.
[c]Significant differences compared to the I-gel group.
[d]Significant difference with the LMA group.

5. Discussion

This prospective randomized study was conducted on 75 patients aged 50 - 65 years who referred for elective eye surgery. Before the start, no significant difference was observed between the groups in terms of hemodynamic parameters while prior to the insertion of the airway devices, the parameters significantly increased in all groups. Heart rate and systolic blood pressure one minute after inserting airway devices still remained significantly high. The increase in heart rate was significantly higher in the ETT group than in the I-gel group and systolic and diastolic blood pressure was significantly higher in the ETT group than in the LMA and I-gel groups. In addition, a significant difference was observed between the LMA and I-gel groups. Two minutes after the insertion of the ETT and LMA, hemodynamic changes in the ETT group were still higher than the changes in the LMA and I-gel groups. Five minutes later, heart rate was higher in the ETT group than in the LMA and I-gel groups and systolic blood pressure was lower in the I-gel group than in the ETT and LMA groups. Overall, our study showed that the hemodynamic parameters changed fewer using the I-gel compared to using the tracheal tube and LMA and the use of LMA was associated with greater stability.

Our results are consistent with the results of Watch MF and colleagues who examined hemodynamic changes in 41 children who used LMA and ETT. They found that there were more changes in hemodynamic parameters in the ETT group compared to the LMA group (13).

Of course, the results of a study conducted by Helmy et al. in 2010 showed contrary results. They found that there was no difference in the use of *LMA Classic*™ and I-gel. There was no significant difference in postoperative complications, except in the LMA group, while nausea and vomiting were higher and the amount of air entering the inside of the stomach was less in the I-gel method than in the LMA method (14).

In another study, Ayedi et al. used I-gel and LMA Classic™ in the two groups of 21 patients and found that time of insertion in the I-gel group was shorter, the post-

operative dysphagia in the first hour was higher in the LMA group, and airway pressure was higher in the group I-gel (15). I-gel and LMA insertion time were not examined in our study.

Oczenski et al. compared hemodynamic changes during the insertion of ETT, Combi-tube, and LMA in 75 patients and concluded that after the insertion of ETT and Combi-tube, a substantial increase occurred in diastolic blood pressure, systolic blood pressure, heart rate, and mean arterial pressure during one minute to ten minutes after the insertion. However, after the insertion of LMA, heart rate did not change significantly, but by the end of the first minute, SBP, DBP, and MAP had a mild increase (16).

In eye surgeries in which we have some limitations in increasing blood pressure after the induction of anesthesia, we recommend using I-gel.

As limitations of the study, we can mention the same dose of atracurium used for tracheal intubation and SGAs and common field with eye surgery that might induce the same complications in the use of SGAs, for instance, nausea and vomiting.

Acknowledgments

We acknowledge the vice chancellor of Deputy of Research and Technology Affairs, Department of Anesthesiology, Pain Research Center, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran, for technical support. We also thank Dr. Mostafa Feghhi and Dr. Sarah Hojjati.

Footnotes

Authors' Contribution: Study concept and design: Reza Akhondzadeh, analysis and interpretation of data and statistical analysis: Salman Vojdani, critical revision of the manuscript for important intellectual control: Reza Akhondzadeh and Seyed Mehdi Aslani, study supervision: Reza Akhondzadeh.

Conflict of Interests: The authors do not have any conflict of interest in this research.

Funding/Support: The financial support was provided by the pain research center, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran.

References

1. Eydi M, Kolahdouzan K, Golzari SE. Effect of intravenous hydrocortisone on preventing postoperative sore throat followed by laryngeal mask airway use in patients undergoing urogenital surgeries. *J Cardiovasc Thorac Res*. 2013;**5**(1):29–33. doi: 10.5681/jcvtr.2013.006. [PubMed: 24251006]. [PubMed Central: PMC3825377].
2. Nesioonpour S, Mokmeli S, Vojdani S, Mohtadi A, Akhondzadeh R, Behaeen K, et al. The effect of low-level laser on postoperative pain after tibial fracture surgery: A single-blind controlled randomized clinical trial. *Anesthesiol Pain Med*. 2014;**4**(3). doi: 10.5812/aapm.17350.
3. Hosseinzadeh H, Golzari SE, Torabi E, Dehdilani M. Hemodynamic changes following anesthesia induction and LMA insertion with propofol, etomidate, and propofol + etomidate. *J Cardiovasc Thorac Res*. 2013;**5**(3):109–12. doi: 10.5681/jcvtr.2013.023. [PubMed: 24252986]. [PubMed Central: PMC3825398].
4. Ziyaeifard M, Azarfarin R, Massoumi G. A comparison of intraocular pressure and hemodynamic responses to insertion of laryngeal mask airway or endotracheal tube using anesthesia with propofol and remifentanil in cataract surgery. *J Res Med Sci*. 2012;**17**(6):503–7. [PubMed: 23626623]. [PubMed Central: PMC3634284].
5. Peirovifar A, Eydi M, Mirinejhad MM, Mahmoodpoor A, Mohammadi A, Golzari SE. Comparison of postoperative complication between laryngeal mask airway and endotracheal tube during low-flow anesthesia with controlled ventilation. *Pak J Med Sci*. 2013;**29**(2):601–5. [PubMed: 24353586]. [PubMed Central: PMC3809272].
6. Mahmoodpoor A, Golzari SE, Hamidi M, Hamidi M, Parish M, Soleimanpour H, et al. Comparison of three methods for laryngeal mask airway insertion in adults: Standard, lateral and rotational. *J Clin Anal Med*. 2015;**6**(1). doi: 10.4328/jcam.1752.
7. Golzari SE, Mahmoodpoor A. Laryngeal Mask Airway in Medical Emergencies. *New Engl J Med*. 2014;**370**(9):882–4. doi: 10.1056/NEJMc1315505.
8. Akhondzade R, Pipelzade MR, Gousheh MR, Sarrafan N, Mahmoodi K. Comparison of the analgesic effect of intra-articular and extra-articular injection of morphine and ketamine compound in arthrotomy lower limb surgery under spinal anesthesia. *Pak J Med Sci*. 2014;**30**(5):942–5. doi: 10.12669/pjms.305.4775. [PubMed: 25225503]. [PubMed Central: PMC4163208].
9. Das B, Mitra S, Jamil SN, Varshney RK. Comparison of three supraglottic devices in anesthetised paralyzed children undergoing elective surgery. *Saudi J Anaesth*. 2012;**6**(3):224–8. doi: 10.4103/1658-354X.101212. [PubMed: 23162394]. [PubMed Central: PMC3498659].
10. Shin WJ, Cheong YS, Yang HS, Nishiyama T. The supraglottic airway I-gel in comparison with ProSeal laryngeal mask airway and classic laryngeal mask airway in anaesthetized patients. *Eur J Anaesthesiol*. 2010;**27**(7):598–601. doi: 10.1097/EJA.0b013e3283340a81. [PubMed: 19915475].
11. Seet E, Yousaf F, Gupta S, Subramanyam R, Wong DT, Chung F. Use of manometry for laryngeal mask airway reduces postoperative pharyngolaryngeal adverse events: A prospective, randomized trial. *Anesthesiology*. 2010;**112**(3):652–7. doi: 10.1097/ALN.0b013e3181cf4346. [PubMed: 20179502].
12. Kahl M, Eberhart LH, Behnke H, Sanger S, Schwarz U, Vogt S, et al. Stress response to tracheal intubation in patients undergoing coronary artery surgery: Direct laryngoscopy versus an intubating laryngeal mask airway. *J Cardiothorac Vasc Anesth*. 2004;**18**(3):275–80. [PubMed: 15232805].
13. Watcha MF, White PF, Tychsen L, Stevens JL. Comparative effects of laryngeal mask airway and endotracheal tube insertion on intraocular pressure in children. *Anesth Analg*. 1992;**75**(3):355–60. [PubMed: 1510256].
14. Helmy AM, Atef HM, El-Taher EM, Henidak AM. Comparative study between I-gel, a new supraglottic airway device, and classical laryngeal mask airway in anesthetized spontaneously ventilated patients. *Saudi J Anaesth*. 2010;**4**(3):131–6. doi: 10.4103/1658-354X.71250. [PubMed: 21189847]. [PubMed Central: PMC2980656].
15. Ayedi M, Zouche I, Smaoui L, Zouari J, Abidi S, Kolsi K. Comparison of two supraglottic airway devices: I-gel and LMA-classic in pediatric anesthesi. *Eur J Anaesthesiol*. 2011;**28**:233. doi: 10.1097/00003643-201106001-00754.
16. Oczenski W, Fitzgerald RD. Hemodynamic and catecholamine stress responses to insertion of the Combitube®, laryngeal mask airway or tracheal intubation. *Anesth Analg*. 2000;**90**(1):232. doi: 10.1097/00000539-200001000-00059.