ORIGINAL ARTICLE

Comparison of endotracheal intubation, laryngeal mask airway, and I-gel in children undergoing strabismus surgery

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Background: Insertion of the advanced airway during induction of general anesthesia can cause undesirable sympathetic stimulation such as increased intraocular pressure (IOP) and hemodynamic parameters. In this study, we compared insertion of three different advanced airway devices; endotracheal tube (ETT), laryngeal mask airway (LMA) and I-gel in terms of IOP, hemodynamic changes and postoperative nausea and vomiting (PONV) following induction of general anesthesia with propofol and remifentanil in children undergoing strabismus surgery. **Materials and Methods:** A total of 90 children (5.68 ± 1.49 years old) were randomly assigned to one of the three groups, ETT, LMA, or I-gel insertion as advanced airway devices IOP and also hemodynamic variables were measured before (T0 and T1) and immediately after (T2) the insertion of these airway devices, although 2 min (T3) and 5 min (T4) after it. PONV was assessed about 2 h after the completion of surgery in the recovery room. **Results:** The mean arterial pressure (MAP), IOP, and systolic and diastolic blood pressures were significantly different between the three groups immediately (T2), 2 min (T3), and 5 min (T4) after the insertion of airway devices. The heart rate (HR) was significantly different between the three groups in all measurement times except of T0. Within-group comparisons showed that the three groups had significant changes in MAP, IOP, HR, systolic and diastolic pressure before and after airway insertion (T1 and T2). The trend in the LMA and ETT groups was descending-ascending-descending, whereas in the I-gel group, it was quite descending. There was no significant difference among the three groups in terms of PONV. **Conclusion:** As a result, our study showed that, compared with LMA and ETT, the I-gel had less impact on undesirable stress responses and seems to be superior to LMA and ETT in children undergoing strabismus surgery.

Key words: Endotracheal intubation, hemodynamic changes, I-gel, intraocular pressure, laryngeal mask airway, postoperative nausea and vomiting

How to cite this article: Allahyari E, Azimi A, Zarei H, Bamdad S. Comparison of endotracheal intubation, laryngeal mask airway, and I-gel in children undergoing strabismus surgery. J Res Med Sci 2021;26:9.

INTRODUCTION

Strabismus surgery is the most common pediatric ophthalmic operational procedure. The surgeon makes an incision through the conjunctiva and tenon fascia and locates the muscles and repositions the extraocular muscles, usually by a proper movement.[1] Strabismus surgery is usually performed under a general anesthetic in a supine position. Propofol has been reported to facilitate intubation without the use of neuromuscular blockers, while remifentanil is a potent fentanyl derivative that facilitates tracheal intubation and allows a rapid return of spontaneous respiration and airway reflexes.[1,2]

Intraocular pressure (IOP), hemodynamic changes, and nausea and vomiting following tracheal intubation are among the concerns of anesthesia with propofol and remifentanil in performing surgical procedures. In these cases, the stress response with the release of catecholamines leads to increased IOP, tachycardia, and hypertension, which can lead to life-threatening risks, particularly in the patients susceptible to cardiovascular

Access this article online
Quick Response Code:
Website: www.jmsjournal.net
DOI: 10.4103/jrms.JRMS_325_19

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Submitted: 28-May-2019; **Revised:** 03-Nov-2019; **Accepted:** 27-Aug-2020; **Published:** 28-Jan-2021

diseases and cerebral problems.[3,4] So far, several methods have been used to avoid the stress response and to prevent IOP, hemodynamic changes, and nausea and vomiting.

Supraglottic airways (SGAs) that are designed for the prevention of injuries caused by the tracheal intubation can be inserted into the pharynx to allow ventilation, oxygenation, and administration of anesthetics as advanced airway devices.[5] SGAs play an established role in airway management in both adults and children with airway problems. Currently, the laryngeal mask airways (LMAs), the laryngeal tube (LT) with integrated suctioning tube, the LT, the ProSeal LMA (PLMA), and the esophageal tracheal combitube (OTC) are the best evaluated and most widespread SGAs.[6]

The LMAs are the SGAs used most commonly in the operating room.[7,8] A typical LMA consists of a hollow shaft connected to a mask-like cuff. The cuff is designed to sit in the hypopharynx, with the tip at the esophageal inlet. It seems that due to the non-placement of LMA, the most important and widely used supraglottic device is today designed to sit in the patient's hypopharynx and cover the supraglottic structures; it allows relative isolation of the trachea within the trachea and causes less irritation.[9,10]

I-gel is also a supraglottic device. It is an innovative second-generation airway device made of thermoplastic elastomer. It is a soft and loose mode and does not cause inflating the cuff. Due to its anatomical design, I-gel operates properly on the perilaryngeal and hypopharyngeal structures. Ease of insertion, lack of movement, less damage to the soft tissue, the simplicity of the structure, and less cost have turned I-gel into a desirable airway device.[11] On the other hand, I-gel is placed in the hypopharynx instead of insertion into the trachea and causes less stress to the patient.[12]

Some relative advantages of the two methods toward each other have been reported in previous studies. For example, Hashemian *et al*. reported that the I-gel is placed easier and can be an alternative to the LMA for controlled ventilation.[13] Park *et al*. (2015) argued that the I-gel has fewer complications such as blood staining, dysphagia, and sore throat than the LMA and offered certain advantages over the LMA in patients under general anesthesia; also, Sahoo *et al*. concluded that I-gel airway was better than LMA in terms of demonstrating better stability of IOP on insertion in children with the normal airway.[14]

In this study, we compared endotracheal intubation (endotracheal tube [ETT]), LMA and I-gel in terms of IOP, hemodynamic changes and postoperative nausea and vomiting (PONV) following induction of anesthesia with propofol and remifentanil in children undergoing strabismus surgery. Obviously, our results showed that there were differences among these methods and their relative advantages in pediatric strabismus surgery.

MATERIALS AND METHODS

Participants

Considering the power of 80% and type I error rate of 5%, 90 children who were candidates for strabismus surgery in Khalili Hospital in Shiraz, Iran, were enrolled. The age of the children was between 3 and 8 years old and all of them participated by their parents' informed consent. By using a simple randomization method, the researcher randomly assigned the participants into one of the three groups, tracheal intubation, LMA, or I-gel. Thirty patients were placed in each group and none of them knew which group they were assigned to. There was not any difference in the cost of these three methods for the patients. Exclusion criteria included glaucoma, history of intraocular surgery, heart and lung diseases, diabetes, BMI >3 kg/m^3, anatomical defects in the mouth and larynx, and airway obstruction.

Procedure

All participants were prohibited from eating and drinking at least 6 h before the surgery. Oral midazolam (0.33 mg/kg) was used for sedation before the surgery, and hemodynamic variables including the systolic and diastolic blood pressures as well as heart rate (HR) were measured in all patients before injection of any anesthetic drugs (T0). The first stage of anesthesia was done before induction of anesthesia by injection of propofol (1 mg/kg) and remifentanil (1 µg/kg) for loss of t consciousness and eyelid reflex, to check the IOP as its baseline values (T1) for three times using tono-pen tonometer (Tono-Pen XL – Reichert), a kind of hand-held applanation tonometer that measures the IOP via touching the cornea. The mean IOP as a baseline was recorded. Furthermore, hemodynamic variables were measured at this time as well (T1). Induction of general anesthesia was performed by injection of propofol (3 mg/kg), remifentanil (1 mg/kg), and atracurium (0.4 mg/kg), and after 3 min, depending on the group in which the patient was located, ETT, LMA, or I-gel was inserted and IOP and hemodynamic variables were measured and recorded immediately after advanced airway insertion (T2), 2 min (T3) and 5 min (T4) after it by a technician who was not aware about the patients' allocation.

Postoperative nausea and vomiting measurement

About 2 h after the surgery, all patients were asked by the mentioned technician to answer how many times they had nausea and vomiting during their recovery from anesthesia.

Statistical analysis

Descriptive statistics, such as mean and standard deviation, were used to describe the results. The repeated measures ANOVA were used to evaluate within-group and between-group differences of IOP and hemodynamic variables at different stages of measurement. Chi-square test was used to compare the frequency of PONV. To describe and analyze the results, we used SPSS, version 22 (Version 20. SPSS Inc., Chicago, IL).

RESULTS

The mean age of the patients was 5.68 ± 1.49 years, and their mean weight was 22.85 ± 5.44 kg. Forty-eight patients were male and 42 were female.

The mean arterial pressure (MAP) was significantly different among the three groups immediately (T2), 2 min (T3), and 5 min (T4) after the insertion of different airway devices. Table 1 shows the comparison of MAP changes among the three groups. The trend of MAP change in ETT and LMA group before the insertion of these airways (T0 to T1) was initially descending, then after insertion was ascending (from T1 to T2), and again descending at the end, while in the I-gel group, it was quite descending from T0 to T4 ($P < 0.001$ in all 3 groups).

We found that the three groups were significantly different in terms of IOP immediately ($P = 0.004$), 2 min ($P < 0.001$), and also 5 min after the insertion of different advanced airways ($P = 0.001$) in comparison to baseline values. Table 2 shows the comparison of IOP changes in the three groups. Within-group comparisons indicated significant changes in IOP in all the three groups from the baseline values (T1) to the last measures (T4). The trend in the LMA and ETT groups was initially descending, then ascending, and again descending at the end, while in the I-gel group, it was quite descending.($P < 0.001$ in all three groups).

The results showed that the HR was significantly different between the three groups before and after the injection of anesthetic drugs (T0 and T1) ($P = 0.002$) and ($P = 0.003$), respectively. However, the HR was not different between the three groups immediately, as well as 2 and 5 min after insertion of advanced airways ($P > 0.05$) [Table 3]. Within-group comparisons showed that the HR changes were statistically significant in all the three groups in all measured times. The trend in the I-gel group was quite descending, but in the LMA and ETT groups, it was initially descending, then ascending after insertion of advanced airways, and again descending at the end ($P < 0.001$ in all 3 groups).

Table 1: Comparison of mean arterial pressure values before and after insertion of advanced airway devices between 3 groups, ANOVA test was applied

MAP	*n*	Mean±SD (mmHg)	Minimum (mmHg)	Maximum (mmHg)	*P*
T0					
LMA	30	93.46±8.96	76.00	113.00	0.742
I gel	30	92.51±7.65	78.33	109.33	
ETT	30	94.24±9.34	77.00	115.67	
Total	90	93.40±8.61	76.00	115.67	
T1					
LMA	30	86.96±10.43	70.00	107.00	0.916
I gel	30	87.65±7.50	74.67	102.00	
ETT	30	87.97±10.32	64.67	111.00	
Total	90	87.53±9.42	64.67	111.00	
T2					
LMA	30	95.06±14.37	73.67	139.33	0.002
I gel	30	86.90±9.17	72.33	105.33	
ETT	30	97.00±9.33	83.33	118.00	
Total	90	92.98±11.9	72.33	139.33	
T3					
LMA	30	94.10±13.56	70.67	118.67	<0.001
I gel	30	82.71±11.05	48.00	102.33	
ETT	30	95.06±10.21	80.33	115.00	
Total	90	90.62±12.87	48.00	118.67	
T4					
LMA	30	88.68±12.00	68.67	113.00	<0.001
I gel	30	79.18±6.92	66.67	91.00	
ETT	30	90.96±9.87	75.67	109.33	
Total	90	86.28±10.98	66.67	113.00	

T0=Baseline; T1=After first injection of anesthetic drug; T2=Immediately after insertion of advanced airway device; T3=Two minutes after insertion of advanced airway device; T4=Five minutes after insertion of advanced airway device. MAP=Mean arterial pressure; SD=Standard deviation; ETT=Endotracheal tube; LMA=Laryngeal mask airway

Table 2: Comparison of intraocular pressure values before and after insertion of advanced airway devices between three groups, ANOVA test was applied

Mean IOP	*n*	Mean±SD	Minimum	Maximum	*P*
T1					
LMA	30	14.76±3.47	8.5	23	0.057
I gel	30	16.35±2.53	11	23	
ETT	30	14.46±3.53	6.5	20	
Total	90	15.19±3.28	6.5	23	
T2					
LMA	30	17.51±3.38	11.5	24	0.004
I gel	30	15.91±2.67	11.5	22	
ETT	30	18.96±4.12	12	28.5	
Total	90	17.46±3.63	11.5	28.5	
T3					
LMA	30	16.41±3.08	11	22	0.000
I gel	30	14.90±2.44	9.5	20	
ETT	30	18.5±3.76	10.5	26	
Total	90	16.60±3.44	9.5	26	
T4					
LMA	30	15.31±2.79	9.5	19.5	0.001
I gel	30	13.76±2.51	9	19.5	
ETT	30	16.78±3.46	10.5	22.5	
Total	90	15.28±3.17	9	22.5	

T1=After first injection of anesthetic drug; T2=Immediately after insertion of advanced airway device; T3=Two minutes after insertion of advanced airway device; T4=Five minutes after insertion of advanced airway device. IOP=Intraocular pressure; SD=Standard deviation; ETT=Endotracheal tube; LMA=Laryngeal mask airway

Table 3: Comparison of heart rate values before and after insertion of advanced airway devices between three groups, ANOVA test was applied

HR	*n*	Mean±SD	Minimum	Maximum	*P*
T0					
LMA	30	103.36±16.89	80	133	0.002
I gel	30	155.73±14.99	91	148	
ETT	30	101.70±16.4	80	140	
Total	90	106.93±17.13	80	148	
T1					
LMA	30	96.76±16.62	73	133	0.003
I gel	30	107.83±14.96	79	140	
ETT	30	93.80±17.67	73	140	
Total	90	99.46±17.37	73	140	
T2					
LMA	30	102.36±16.61	71	129	0.471
I gel	30	105.66±11.92	83	128	
ETT	30	107.93±22.61	75	180	
Total	90	105.32±17.55	71	180	
T3					
LMA	30	98.43±15.97	72	127	0.493
I gel	30	101.36±11.26	80	120	
ETT	30	103.13±18.13	63	140	
Total	90	100.97±15.34	63	140	
T4					
LMA	30	94.83±15.04	70	120	0.689
I gel	30	91.56±16.92	18	117	
ETT	30	95.43±22.97	18	140	
Total	90	93.94±18.49	18	140	

T0=Baseline; T1=After first injection of anesthetic drug; T2=Immediately after insertion of advanced airway device; T3=Two minutes after insertion of advanced airway device; T4=Five minutes after intubation. HR=Heart rate; SD=Standard deviation; ETT=Endotracheal tube; LMA=Laryngeal mask airway

The systolic blood pressure was significantly different among the three groups immediately (T2) ($P = 0.002$), 2 min (T3), and 5 min (T4) after the insertion of advanced airways. However, there were not significant differences between the three groups regarding this parameter before the insertion of advanced airways ($P > 0.05$) [Table 4]. In addition, within-group comparisons showed that systolic blood pressure changes were statistically significant in all the three groups from the pre-anesthetic stage to 5 min after airway insertion. The trend in the I-gel group was quite descending ($P < 0.001$), and in the LMA ($P = 0.001$) and ETT ($P < 0.001$) groups, it was initially descending, then ascending with these airway insertions, and again descending at the end.

Finally, as Table 5 shows, our results demonstrated that the diastolic blood pressure was significantly different among the three groups immediately (T2) ($P = 0.006$), 2 min (T3) ($P = 0.002$), and also 5 min (T4) after the insertion of advanced airway devices ($P = 0.002$). However, the diastolic blood pressure was not different in the three groups before the insertion of these devices ($P > 0.05$). Moreover, within-group comparisons showed that the diastolic blood pressure changes were also statistically significant in all the three groups from the baseline values to the end (T0 to T4). The diastolic blood pressure was quite descending in the I-gel group ($P < 0.001$), whereas in the LMA ($P < 0.001$) and ETT ($P = 0.004$) groups, it was initially descending (T0 to T1), then ascending (T1 to T2), and again descending at the end (T2 = to T4).

Four patients in the LMA group and five in the ETT group had PONV. However, no one in the I-gel group had PONV. Chi-square test did not show statistically significant differences among the three groups ($\chi^2 = 5.185$, $P = 0.075$).

DISCUSSION

The present study showed that using the I-gel device was not associated with an increase in hemodynamic variables such as the systolic and diastolic blood pressure, MAP and HR, while both the LMA and the ETT caused a significant increase in these variables. Therefore, it seems that the I-gel does not induce a stress response in pediatric patients undergoing general anesthesia for strabismus surgeries. Our findings are in line with those of several previous studies, which all reported no significant changes in hemodynamic variables during the I-gel insertion.

For example, Ismail *et al*. have shown that the insertion of the I-gel provides fewer changes in hemodynamic

Table 4: Comparison of systolic blood pressure values before and after insertion of advanced airway device between three groups, ANOVA test was applied

Systolic BP	*n*	Mean±SD	Minimum	Maximum	*P*
T0					
LMA	30	119.60±11.97	96	146	0.139
I gel	30	118.86±13.35	93	141	
ETT	30	113.66±12.05	98	138	
Total	90	117.37±12.61	93	146	
T1					
LMA	30	111.83±12.47	90	138	0.054
I gel	30	112.70±12.84	90	133	
ETT	30	105.73±10.48	84	128	
Total	90	110.08±12.24	84	138	
T2					
LMA	30	123.06±15.98	95	168	0.002
I gel	30	110.56±14.14	86	136	
ETT	30	121.06±11.33	103	148	
Total	90	118.23±14.85	86	168	
T3					
LMA	30	122.43±15.97	88	154	<0.001
I gel	30	102.26±22.52	10	134	
ETT	30	118.86±11.38	99	145	
Total	90	114.52±19.20	10	154	
T4					
LMA	30	116.26±15.75	82	143	<0.001
I gel	30	98.23±11.07	80	125	
ETT	30	114.10±11.24	95	136	
Total	90	109.53±15.08	80	143	

T0=Baseline; T1=After first injection of anesthetic drug; T2=Immediately after insertion of advanced airway device; T3=Two minutes after insertion of advanced airway device; T4=Five minutes after insertion of advanced airway device; BP=Blood pressure; SD=Standard deviation; ETT=Endotracheal tube; LMA=Laryngeal mask airway

Table 5: Comparison of diastolic blood pressure values before and after insertion of advanced airway device between three groups, ANOVA test was applied

Diastolic-BP	*n*	Mean±SD	Minimum	Maximum	*P*
T0					
LMA	30	84.40±9.29	66	100	0.086
I gel	30	79.33±9.28	66	99	
ETT	30	84.53±9.83	66	107	
Total	90	81.42±9.63	66	107	
T1					
LMA	30	74.53±11.23	60	103	0.192
I GEL	30	75.13±8.13	65	96	
ETT	30	79.10±11.70	55	105	
Total	90	76.25±10.55	55	105	
T2					
LMA	30	81.06±14.95	56	125	0.006
I gel	30	75.06±9.76	58	90	
ETT	30	84.96±9.75	70	108	
Total	90	80.36±12.32	56	125	
T3					
LMA	30	79.93±13.51	55	103	0.002
I gel	30	72.93±9.04	50	89	
ETT	30	83.16±10.76	66	106	
Total	90	78.67±11.93	50	106	
T4					
LMA	30	74.90±12.33	55	100	0.002
I gel	30	69.66±6.91	55	80	
ETT	30	79.40±10.47	60	100	
Total	90	74.65±10.81	55	100	

T0=Baseline; T1=After first injection of anesthetic drug; T2=Immediately after insertion of advanced airway device; T3=Two minutes after insertion of advanced airway device; T4=Five minutes after insertion of advanced airway device; BP=Blood pressure; SD=Standard deviation; ETT=Endotracheal tube; LMA=Laryngeal mask airway

variables, compared with the insertion of LMA or ETT in patients undergoing elective non-ophthalmic surgery.[15] In a prospective randomized comparative study, Biswas *et al*. demonstrated that there was a significant increase in the HR at the 1st and 45th min and increased in MAP at the 15th and 30th min in the ETT group compared to the I-gel group.[16] They concluded that an increase in serum cortisol after insertion in the ETT group, as compared to the I-gel group, had caused hemodynamic alterations. Pratheeba *et al*. argued that an easier and shorter duration of insertion, with less hemodynamic alteration, makes I-gel a suitable alternative to LMA during general anesthesia.[17] and also Dhanda *et al*. concluded that the I-gel was a reasonable alternative to ETT for pressure-controlled ventilation.[18]

Our study also showed that the frequency of nausea and vomiting in the I-gel group was significantly lower than that of the LMA and ETT groups, and this was consistent with previous studies. For example, Helmy *et al*. reported that nausea and vomiting were significantly higher in the LMA group than I-gel patients.[19] Furthermore, Massoud *et al*. (2014) argued that I-gel was better than the ETT regarding hemodynamic stability changes, and its associated postoperative complications such as dysphagia, dysphonia, nausea, and vomiting were lower than the ETT group.[20] However, Jahanbakhsh *et al*. reported that the incidence of PONV, 6 h and 18 h after the strabismus surgery, was similar in both LMA and ETT groups.[21] The cause of the difference between the results of this study and other studies may be the administration of possurgical anti-nausea drugs.

Furthermore, our study showed that, compared with ETT and LMA, I-gel increased the IOP to a lesser extent, and this is also confirmed by the results of previous studies. In this line, Ismail *et al*. showed that the insertion of the I-gel did not increase IOP, while the insertion of an ETT or LMA increased IOP significantly.[15] The trend of IOP changes during anesthesia has been investigated in previous studies. Propofol and remifentanil are among anesthetic agents that reduce the IOP, but after intubation, IOP rises to different levels according to the method of intubation. Thus, individual IOP levels rise and fall during anesthesia, depending on the time point of measurement. The lowest

IOP can be measured immediately after the induction of anesthesia. Therefore, the time when IOP is measured should be recorded.[22-24]

As a result, the study showed that, compared with LMA and ETT, the I-gel has less impact on stress responses such as hemodynamic changes and HR, and to a lesser extent, it changes the IOP. In addition, no one in the I-gel group reported PONV, while some patients in the other two groups reported PONV, although it was not statistically significant it can be investigated in future to show its possible effect on it. Therefore, I-gel seems to be superior to LMA and ETT in children undergoing general anesthesia as an advanced airway device in strabismus surgeries.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Rodgers A, Cox RG. Anesthetic management for pediatric strabismus surgery: Continuing professional development. Can J Anaesth 2010;57:602-17.
2. James I. Anaesthesia for paediatric eye surgery. Continuing Educ Anaesthesia Critical Care Pain 2008;8:5-10.
3. Ahmad N, Zahoor A, Riad W, Al Motowa S. Influence of GlideScope assisted endotracheal intubation on intraocular pressure in ophthalmic patients. Saudi J Anaesth 2015;9:195-8.
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;17:503-7.
5. Timmermann A. Supraglottic airways in difficult airway management: Successes, failures, use and misuse. Anaesthesia 2011;66 Suppl 2:45-56.
6. Bein B, Scholz J. Supraglottic airway devices. Best Pract Res Clin Anaesthesiol 2005;19:581-93.
7. Jagannathan N, Sequera-Ramos L, Sohn L, Wallis B, Shertzer A, Schaldenbrand K. Elective use of supraglottic airway devices for primary airway management in children with difficult airways. Br J Anaesth 2014;112:742-8.
8. Kristensen MS, Teoh WH, Asai T. Which supraglottic airway will serve my patient best? Anaesthesia 2014;69:1189-92.
9. Golzari SE, Mahmoodpoor A. Laryngeal mask airway in medical emergencies. N Engl J Med 2014;370:883.
10. Das B, Mitra S, Jamil SN, Varshney RK. Comparison of three supraglottic devices in anesthetised paralyzed children undergoing elective surgery. Saudi J Anaesth 2012;6:224-8.
11. 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;27:598-601.
12. Kahl M, Eberhart LH, Behnke H, Sänger 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;18:275-80.
13. Hashemian SM, Nouraei N, Razavi SS, Zaker E, Jafari A, Eftekhari P, *et al*. Comparison of i-gel™ and laryngeal mask airway in anesthetized paralyzed patients. Int J Crit Illn Inj Sci 2014;4:288-92.
14. Sahoo AK, Sethi S, Ghai B, Ram J. Comparison of i-gelTM Airway with Laryngeal Mask Airway SupremeTM in children undergoing elective cataract surgeries. Acta Anaesth 2017;68:19-24.
15. Ismail SA, Bisher NA, Kandil HW, Mowafi HA, Atawia HA. Intraocular pressure and haemodynamic responses to insertion of the i-gel, laryngeal mask airway or endotracheal tube. Eur J Anaesthesiol 2011;28:443-8.
16. Biswas S, Mandal S, Mitra T, De Ray S, Chanda R, Sur D. A prospective randomized comparative study to compare the hemodynamic and metabolic stress respone due to endotracheal intubation and i-gel usage during laparoscopic cholecystectomy. Middle East J Anaesthesiol 2015;23:315-20.
17. Pratheeba N, Ramya GS, Ranjan RV, Remadevi R. Comparison of i-gel™ and laryngeal mask airway Classic™ in terms of ease of insertion and hemodynamic response: A randomized observational study. Anesth Essays Res 2016;10:521-5.
18. Dhanda A, Singh S, Bhalotra AR, Chavali S. Clinical comparison of I-gel supraglottic airway device and cuffed endotracheal tube for pressure-controlled ventilation during routine surgical procedures. Turk J Anaesthesiol Reanim 2017;45:270-6.
19. 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;4:131-6.
20. Massoud SM, Soud DE, Helmy KM, Elsayed MA. A comparative study between i gel versus cuffed endotracheal tube in laparoscopic surgeries in adult patients. Zagazig Univ Med J 2015;20:372-8.
21. Jahanbakhsh S, Fathi M, Dalir B, Izanloo A, Bastani F. Comparing the incidence of postoperative nausea and vomiting after strabismus surgery between laryngeal mask airway vs. endotracheal intubation. Anesthesiol Pain 2014;5:54-63.
22. Termühlen J, Gottschalk A, Eter N, Hoffmann EM, Van Aken H, Grenzebach U, *et al*. Does general anesthesia have a clinical impact on intraocular pressure in children? Paediatr Anaesth 2016;26:936-41.
23. Mikhail M, Sabri K, Levin AV. Effect of anesthesia on intraocular pressure measurement in children. Surv Ophthalmol 2017;62:648-58.
24. Tuzcu K, Tuzcu EA, Karcioglu M, Davarci I, Coskun M, Ilhan O, *et al*. The effects of remifentanil and esmolol on increase in intraocular pressure due to laryngoscopy and tracheal intubation: A double-blind, randomized clinical trial. J Glaucoma 2015;24:372-6.