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Original Article

COMPARISON OF INTRAOCULAR PRESSURE AND HAEMODYNAMIC RESPONSES TO INSERTION OF THE I - GEL AND ENDOTRACHEAL TUBE IN ELECTIVE OPHTHALMOLOGICAL SURGERIES

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ABSTRACT

Objective: To compare I–Gel versus endotracheal tube effects on hemodynamic stability and intraocular pressure in patients undergoing elective ophthalmological surgeries.

Study Design: Quasi-experimental study.

Place and Duration of Study: Armed Forces Institute of Ophthalmology, Rawalpindi Pakistan, from Nov 2019 to Oct 2020.

Methodology: A total of 108 patients undergoing elective ophthalmological surgeries under general anesthesia from both genders, age range between 18-45 years, American Society of Anesthesiologists status I or II were included. General anesthesia given following standard procedures and monitoring. Heart rate, Systolic & Diastolic blood pressure monitored and intra-ocular pressure measured in each eye with Reichert ton open at baseline, upon insertion of airway device and 5 minutes after insertion.

Results: Total 108 patients enrolled in the study with a mean age of 37.74 ± 6.0 years and age-range of 18-45. Heart rate at Insertion in I-Gel group was 78.14 ± 3.41 beats per minute whereas in intubated group was 97.20 ± 2.84 beats per minute, mean systolic blood pressure at insertion in group A and B was 115.28 ± 5.3 and 130.44 ± 2.81mm of Hg respectively. Intraocular pressure at insertion right eye in group A and B was 12.04 ± 0.48 and17.98 ± 0.42 mm of Hg respectively. Intraocular pressure at insertion left eye in group A was 12.12 ± 0.45 whereas in group B was 17.95 ± 0.38mm of Hg (*p*-value=0.001).

Conclusion: I–Gel provides better hemodynamic profile and intraocular pressure stability when compared with endotracheal tube.

Keywords: Endotracheal intubation, Hemodynamics, Intraocular pressure.

INTRODUCTION

Endotracheal intubation aided with laryngoscopy is the most conventional and oldest method of securing definitive airway and provision of general anesthesia. However, laryngoscopy accompanied by sympathetic stimulation and raised catecholamines leading to increased heart rate, systolic and diastolic blood pressure; therefore, increased mean increased arterial pressure consequently increased intraocular pressure and intracranial pressure. Hence can produce deleterious effects in ocular and cranial surgeries[1,2].

Intraocular pressure increase due to sympathetic stimulation causes vasoconstriction therefore, raised central venous pressure and systemic arterial pressure. These transitory symptoms can go unnoticed without significant manifestations in normal individuals but it can be detrimental in patients with hypertension, myocardial or cerebrovascular comorbidities[3,4].

Eye pressure measured with tonometer in millimetres of mercury (mmHg), normal range 12-22mm Hg, pressure beyond 22 mm Hg is referred higher however if an individual does not show any manifestations it is called as ocular hypertension[5].

This rise in intraocular pressure during induction, laryngoscopy and endotracheal intubation is of extreme concern in patients with acute glaucoma and open globe injuries where even minimal changes can be deleterious and critical, resulting in reduced disc perfusion and ischemia leading to expulsion of ocular contents. Therefore, to achieve successful outcome these small-sustained effects on intraocular pressure and hemodynamics are kept in mind and safe practices to be adopted[6,7].

Supraglottic devices (laryngeal mask airway and I–Gel) are newer adjuvants in anesthesia and airway devices with ease of insertion and better hemodynamic profile. Endotracheal intubation side effects such as cough, bucking on tube and postoperative sore throat can be avoided. There is an increasing trend towards utilization of these newer generation devices wherever applicable with safety[8].

Dr Archie Brain, a British anaesthetist introduced laryngeal mask airway (LMA) in 1983, it is a supraglottic airway device with an inflatable cough providing a low-pressure seal around the larynx and therefore

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allow ventilation. Intubating LMA can serve as a conduit for tracheal intubation as well. Its ease of administration has made LMA a mandatory component of emergency trolley[9].

Refinements were constantly uttered in primary laryngeal mask airway, therefore, led to the development of I-Gel in the 2007 by Dr Muhammad Aslam Nasir, Physician graduated from Nishtar Medical College Multan, Pakistan. This single-use supraglottic device offers advantages of non-inflatable cuff and a suction port[10].

Rationale of our research was that I-Gel provides better operative conditions versus endotracheal intubation regarding intraocular pressure (IOP) and mean arterial pressure (MAP) upon insertion of airway device in ophthalmological surgeries wherever applicable with safety.

METHODOLOGY

This quasi-experimental study was carried out a Armed Forces Institute of Ophthalmology from November 2019 to October 2020, approval taken from ethics research committee of the institute (225/ERC).

The minimum sample size required for this study was calculated to be 48 (24 in each study group), considering effect size of 1.5 (mean difference between groups of 2.7 and pooled standard deviation of 1.7)*, 95% confidence interval, 80% study power and 10% dropout adjustment[11].

With consecutivenon-probability sampling total n=108 patients enrolled allocated to two groups A-I Gel (n=54) and B-ETT (n=54). As per study protocol, all the patients interviewed, briefed, counselled about the procedure and informed written consent taken. Before reporting to the operation theatre, a detailed pre-anesthesia assessment carried out in all patients with necessary laboratory evaluation parameters to adhere with our inclusion and exclusion criteria, besides, to ensure patient safety, utmost concern in anesthetic management.

Patients undergoing elective ophthalmological surgeries under general anesthesia from both genders with an age range between 18-55 years, American Society of Anesthesiologist's (ASA) status I, II or III were enrolled. Non-consenting patients, pregnant and lactating females, cardiovascular or ischemic diseases, body mass index >30, full stomach patients, difficult airway and other contraindications to I-Gel were excluded from the study.

As pre-operative preparation, completion of essential documentation and an overnight fast/Nil per oral ensured. On the day of surgery, patients brought to operation theatre and before initiating general anesthesia, standard monitoring such as blood pressure (non-invasive method), pulse oximeter (SpO2), endtidal carbon dioxide (ETCO2) and electrocardiography electrodes attached.

18G IV cannula passed under aseptic conditions. Premedication performed with intravenous injections of nalbuphine 0.1 mg/kg, paracetamol 15 mg/kg, dexamethasone 0.08 mg/kg and metoclopramide 0.1mg/kg. Patients were Pre oxygenated with 100% oxygen for 3 minutes. Induction performed with intravenous propofol at a dose of 2mg/kg and muscle relaxation achieved with 0.5 mg/kg of intravenous injection atracurium followed by laryngoscopy and intubation by a qualified anesthetist 3 minutes later in case of endotracheal intubation. In case of I-Gel muscle relaxant was not given instead depth of anesthesia achieved with inhalational anesthetic (sevoflurane) before inserting I-gel. Inhalational anestheticisoflurane and injection atracurium 0.1mg/Kg used for maintenance in the intubated group. Meticulous intraoperative monitoring ensured, heart rate and mean arterial pressure below 20% was considered abnormal, respiratory rate and tidal volume were adjusted to achieve ETCO2 between 35-40 mmHg and SpO2 between 98-100%. At the end of surgery, muscle relaxant was antagonized with intravenous neostigmine + glycopyrrolate in endotracheal tube group whereas in I-Gel group reversal was not required.

Baseline heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP) measured with noninvasive blood pressure and intraocular pressure (IOP) in each eye measured using Reichert tonopen. Three drops of Topical Anesthetic Instilledin each eye before measuring intraocular pressure. Parameters recorded at baseline, upon insertion of airway device and 5 minutes after insertion.

Data entered and analyzed using Statistical Package for Social Sciences (SPSS) version 22. Quantitative variables including age presented as mean and standard deviation. Qualitative variables including gender, American Society of Anesthesiologists Status, device presented in terms of frequency and percentages. Independent sample t–tests used to compare categorical variables. The p-value of ≤ 0.05 considered statistically significant.

RESULTS

A total of 108 patients enrolled in the study with a mean age of 37.74 ± 6.0 years and age-range of 18-45 years (table–I).

Table–I: Distribution of demographic profile (n=100).

		n (%)
ASA Status	I	44 (40.7%)
	II	64 (59.3%)
Gender	Male	67 (62.0%)
	Female	41 (38.0%)
Mallampati Classification	I	45 (44.6%)
	II	65 (65.4%)

Heart rate (HR) at Insertion in I-Gel group was 78.14 ± 3.41 whereas in intubated group was 97.20 ± 2.84, mean systolic blood pressure (SBP) at insertion group A and B was 115.28 ± 5.3 and 130.44 ± 2.81 respectively. Intraocular pressure at insertion in right (R) eye group A and B was 12.04 ± 0.48 and 17.98 ± 0.42 respectively. Intraocular pressure at insertion in left (L) eye in group A was 12.12 ± 0.45 whereas in group B was17.95 ± 0.38 mm of Hg (p-value=0.001) (table–II).

Table-II: Comparison of heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (SBP), intraocular pressure (IOP).

	Group A (n=50) Mean ± SD	Group B (n=50) Mean ± SD	*p*-value
Baseline Heart Rate	78.13 ± 3.60	77.70 ± 3.37	0.52
Heart Rate at Insertion	78.28 ± 3.4	97.20 ± 2.84	0.001*
Heart Rate after 5 mins of Insertion	77.67 ± 3.34	77.89 ± 3.60	0.74
Baseline Systolic Blood Pressure	115.08 ± 6.45	117.02 ± 5.5	0.13
Systolic Blood Pressure at Insertion	115.46 ± 5.3	130.09 ± 3.2	0.001*
Systolic Blood Pressure after 5 minutes of Insertion	113.72 ± 6.9	118.64 ± 4.65	0.001*
Baseline Diastolic Blood Pressure	78.13 ± 3.63	77.96 ± 3.31	0.80
Diastolic Blood Pressure at Insertion	78.37 ± 3.15	88.46 ± 5.5	.001*
Diastolic blood pressure after 5 minutesof Insertion	76.76 ± 4.35	77.11 ± 3.8	.65
Baseline Intra ocular pressure (R) Eye	12.20 ± 0.64	12.13 ± 0.64	.48
Intra ocular pressure at Insertion (R) Eye	12.04 ± 0.48	17.98 ± 0.43	.001*
Intraocular pressure after 5 minutesof Insertion (R)	12.27 ± 0.62	12.16 ± 0.62	.36
Baseline Intraocular pressure (L) Eye	12.27 ± 0.62	12.13 ± 0.64	.24
Intraocular pressure at Insertion (L) Eye	12.12 ± 0.45	17.98 ± 0.43	.001*
Intra ocular pressure after 5 minutes of Insertion (L) Eye	12.27 ± 0.62	12.15 ± 0.64	.35

**significant p-value; p-value was calculated by applying Independent sample t-test*

DISCUSSION

Data analysis of research interpreted statistically significant stability of hemodynamic parameters and intraocular pressure in I–Gel versus endotracheal tube.

Ismail *et al* determined intraocular pressure and hemodynamics response to insertion of the I-Gel, laryngeal mask airway or endotracheal tube in non-ophthalmological surgeries. We suspected that endotracheal intubation leads to increase in intraocular pressure due to incidence of cough (p=0.005) therefore their findings that intraocular pressure was significantly raised after insertion of the endotracheal tube (11.6 ± 1.6 to 16.5 ± 1.7 mmHg) when compared with I–Gel (p<0.001) supports our conclusion[11].

Perello *et al* analysed proseal laryngeal mask airway during extubation of neurosurgical patients. They concluded that replacing the endotracheal tube with laryngeal mask airway in neurosurgical patients upon emergence provides favourable hemodynamic status with decreased incidence of cough and cerebral hyperemia. Endotracheal group showed greater heart rate and mean arterial pressure (p-value 0.03) and these findings are comparable with our study results upon insertion (p-value 0.001)[12].

Poloch *et al* evaluated the usefulness of the laryngeal mask for general anaesthesia in microsurgery of the eye. With endotracheal tube insertion intraocular pressure raised to 15 mmHg in healthy eye and 13.6 mmHg in affected eye while reduced in laryngeal mask airway group to 5.5 mmHg and 7.43 mmHg, respectively. Moreover coughing, stridor and sore throat more pronounced in endotracheal group. Hence, there research supported our evaluation of intraocular pressure[13].

Guerrier *et al* performed randomized controlled trial to compare supraglottic airway device I-Gel and an endotracheal intubation, in penetrating and lamellar keratoplasty performed under general anesthesia. They concluded that the use of I-Gel reduces the risk of ocular hypertension and reduces recovery time, findings consistent with our study. Statistically significant difference of cough at extubation was observed in endotracheal tube group (p<0.001). There was not any considerable difference in stridor and sore throat between two groups[14].

Panner *et al* compared I-Gel versus endotracheal tube in patients undergoing elective caesarean section in a prospective randomized controlled trial to observe hemodynamic response at insertion and extubation. They observed that approximately 20% rise in mean arterial pressure and heart rate seen in endotracheal group when compared with I–Gel group (p<0.001) thus providing greater hemodynamic stability, similar response seen in our study (p-value 0.001). They compared both groups in terms of postoperative complication of blood on the device, which was not conspicuous in either of the groups[15].

Ziyaeifard *et al* compared intraocular pressure and hemodynamic responses to the insertion of laryngeal mask airway or endotracheal tube using general anaesthesia with propofol and remifentanil in cataract surgery. They did not observe any significant difference in heart rate, systolic & diastolic pressure and intraocular pressure contradictory to our evaluation, but laryngeal mask airway insertion was preferred due to ease of insertion and less trauma when compared with an endotracheal tube, therefore, preferred in cataract surgery. Further elaborated I–Gel causes more trauma when compared with endotracheal intubation (p=1.00)[16].

Igboko *et al* studied effects on intraocular pressure in endotracheal (ETT) and laryngeal mask airway (LMA) upon insertion and extubation. Insertion of the airway device caused an immediate rise in IOP of 4.6% in the LMA group (from 13.1 ± 2.4 to 13.7 ± 2.4 mmHg) and 49.2 in the ETT group (from 12.0 ± 2.5 to 17.9 ± 4.0 mmHg) (p<0.001). Cardiovascular responses accompanied IOP changes. As per results, laryngeal mask airway offer greater stability of intraocular pressure along with hemodynamic parameters when compared with endotracheal group (p-value <0.001), findings consistent with our results (p-value 0.001)[17].

Bhardwaj *et al* in their study estimated effects of insertion of laryngeal mask airway on intraocular pressure in the paediatric population with glaucoma. Intraocular pressure was significantly raised in endotracheal group as compared to laryngeal mask airway at 2 minutes (p=0.004) and 5 minutes (p=0.01) after the device insertion. As in our case intraocular pressure at insertion of airway device (p-value 0.001) however no significant difference noted at 5 minutes (p-value 0.88 & 0.99 for right and left eye respectively)[18].

Dumas *et al* compared the safety of endotracheal tube with laryngeal mask airway in patients undergoing dacryocystorhinostomy (DCR) surgery. In their opinion, use of laryngeal mask airway for airway control during DCR surgery is much recommended than endotracheal tube on of ease of insertion, airway protection and favourable hemodynamic profile A 30% increase in heart rate from baseline after intubation (ETT 10.8%, LMA 1.8%, p=0.010). Airway management with an LMA was also less difficult compared with an ETT (ETT 5.7%, LMA 0.5%, p=0.035)[19].

Khot *et al* conducted a randomized controlled trial to estimate effects of endotracheal tube, laryngeal mask airway and I–Gel insertion on hemodynamic profile and intraocular pressure. They proved that I–Gel provides stable intraocular pressure, heart rate, systolic and diastolic blood pressure as compared to laryngeal mask airway and endotracheal tube. Insertion of an endotracheal tube increased IOP from 11.53 ± 1.3 to 18.36 ± 1.6 mmHg (p<0.001). The post-insertion IOP exceeded the pre-induction value 12.5 ± 1.4. Insertion of the LMA increased IOP from 11.65 ± 1.29 to 13.5 ± 1.88 mmHg (p<0.001), did exceed the pre-induction value (12.57 ± 1.39) but slightly. Tracheal intubation significantly increased HR, SBP and DBP. Insertion of the LMA significantly increased HR and SBP. These increases were significantly higher than which followed insertion of the I-Gel device. Results are relevant to our evaluation as enumerated (table–II)[20].

Therefore, significant findings of our study are that I–Gel in contrast to endotracheal intubation provides better anesthetic considerations in elective ophthalmological surgeries. Moreover, it reduces recovery time therefore facilitating in busy surgical schedule in operation theatre. Although endotracheal intubation is the oldest and standard method of securing airway but newer trends in anesthesia can be adopted weighing risk-benefit ratio to pace up with evolutions in the surgical field.

CONCLUSION

I–Gel provides better hemodynamic profile and intraocular pressure stability when compared with endotracheal tube.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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