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Original Research Article

A COMPARATIVE RANDOMIZED CONTROLLED STUDY OF KINGVISION VIDEO LARYNGOSCOPE, AIRTRAQ VIDEO LARYNGOSCOPE AND MACINTOSH LARYNGOSCOPE

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ABSTRACT

Background: Video laryngoscopes are being increasingly used in practice as they offer advantages over Macintosh laryngoscope in management of difficult airway. The present study was aimed at comparing Kingvision and Airtraq video laryngoscopes with Macintosh laryngoscope regarding ease of intubation using intubation difficulty scale (IDS) score in patients without anticipated difficult airway.

Materials and Methods: A total of 90 patients of either sex, belonging to ASA physical status I & II, undergoing elective surgery under general anaesthesia and having simplified airway risk index (SARI) score of less than 4 were randomized to three groups, group K - Kingvision (n=30), group A - Airtraq (n=30) and group M – Macintosh (n=30). Primary objective of the study was to compare ease of intubation using IDS score in both the groups. Secondary objectives included time taken for intubation (TI), haemodynamic stress response and incidence of airway trauma.

Results: Mean IDS score was significantly lower in group K (0.2 ± 0.55) and group A (0.26 ± 0.639) in comparison to group M (1.9 ± 1.953) ($P < 0.001$). Need for multiple intubation attempts, laryngeal pressure, and excess lifting force was significantly less in groups K and A. TI was significantly longer in group K (27.2 ± 4.01) and group A (26.43 ± 3.98) in comparison to group M (17.56 ± 5.29) (P=0.001).

Conclusion: Though the time required for intubation was more, Kingvision and Airtraq video laryngoscopes provide better intubating conditions with greater ease of intubation, better visualization of glottis, lower IDS scores and better hemodynamic stability in patients without anticipated airway difficulty in comparison to Macintosh laryngoscope.

Keywords: Videolaryngoscope, Kingvision, Airtraq, Macintosh, IDS score, intubation.

INTRODUCTION

Securing the airway with endotracheal intubation is a prerequisite for multitude of surgeries under general anaesthesia. The most commonly known and deployed laryngoscope blade for orotracheal intubation is still the Macintosh blade. Difficulties in securing the airway can cause serious soft tissue injuries in the upper airway and lead to hypoxemic anaesthetic mortality and brain injury. Unanticipated difficult intubation is one of the leading causes of mortality and morbidity in anaesthesia practice. Even the most experienced anaesthesiologist may encounter difficulties with conventional direct laryngoscopy; hence, alternative techniques and equipment for endotracheal intubation (ETI) must be

readily available in case of anticipated and unanticipated difficult intubation.

Video laryngoscopes are very safe and facilitate successful endotracheal intubation in such patients without causing further damage. The Kingvision video laryngoscope is a novel laryngoscope that integrates a high-resolution camera. The video image is displayed on an LCD monitor affixed to the blade. The primary objective of the Kingvision video laryngoscope is to provide an optimal visual experience for intubation through the utilization of video and digital technology. The device is equipped with two blade types, one with a channel and the other without a channel. Airtraq is a disposable, indirect laryngoscope that was first used in clinical settings in 2005. It features an unusually curved blade with internal optical lenses and a mechanism to prevent the distal lens from fogging. It allows for a clear view of the glottis without the need to align the oral, pharyngeal, and tracheal axis.

A prospective study was conducted to evaluate the optimal intubating conditions using Kingvision video laryngoscope, Airtraq video laryngoscope and Macintosh laryngoscope in adult patients undergoing elective surgery under general anaesthesia.

MATERIALS AND METHODS

The present study was carried out in 90 patients of either sex in the age group of 20-60 years of ASA physical status I and II with SARI score less than 4, in the department of Anaesthesiology and critical care, at government general hospital, Kadapa during the study period from January 2023 to December 2023. The study was conducted after obtaining ethical committee clearance and written informed consent from patients. Patients with cervical spine injury and anticipated difficult intubation (SARI score > 4) were excluded from the study.

All the patients were randomly allocated into three groups using computer generated random numbers with 30 patients in each group. Patient blinding was done using opaque sealed envelope method. On the day of surgery, an anaesthesiologist not involved in the study opened the sealed, opaque envelope and performed intubation using Kingvision video laryngoscope, Airtraq video Laryngoscope or Macintosh laryngoscope. The anaesthesiologist who recorded intubation difficulty scale (IDS) score was unaware of group allocation.

GROUP- K (n=30): Orotracheal intubation was done using Kingvision Video laryngoscope.

GROUP- A (n=30): Orotracheal intubation was done using Airtraq Video laryngoscope.

GROUP- M (n=30): Orotracheal intubation was done using Macintosh laryngoscope.

During preoperative visit, patient's detailed history, general physical examination, and systemic examination were evaluated. Airway assessment was done using Modified mallampati classification and SARI score.

Modified mallampati classification: It is a frequently performed test that examines the size of the tongue in relation to the oral cavity. Class I: The palatal arch, including the bilateral faucial pillars and bases of the pillars are visible, Class II: The upper part of the pillars and the uvula are visible, Class III: Only the soft and hard palates are visible, Class IV: Only the hard palate is visible.

Sari score 1:

Table 1: Simplified Airway Risk Index

	Parameter	0 point	1 point	2 points
1	Mouth opening	>4 cm	<4 cm	
2	Thyromental Distance	>6.5 cm	6 to 6.5 crn	<6 cm
3	Modified Mallampati grading	I or Il	III	IV
4	Neck movement	> 90°	80° to 90°	< 80°
5	Underbite	Can protrude jaw	Cannot protrude jaw	
6	Body weight	< 90 kg	90 to 110 kg	> 110 kg
7	Previous intubation history	No difficulty	unsure or unknown	Known difficulty
	Score > 4 - predictor of difficult intubation			

Routine investigations like haemoglobin, blood grouping and typing, bleeding time and clotting time, blood sugar, blood urea, serum creatinine, chest X-ray and ECG were done in all patients. Demographic characters like age, sex, height, and weight were recorded, and written informed consent was obtained. All the patients received Tab. Ranitidine 150mg and Tab. Alprazolam 0.5 mg orally on the night before surgery.

The patients were shifted to the operative room after checking for informed consent and nil per oral status. The patients were connected to ASA standard monitors – Non-invasive blood pressure (NIBP), ECG, Pulse oximeter (SpO2), Capnography. 18G Intravenous line was secured. Baseline vital parameters - blood pressure, heart rate, and SpO2 were noted. All patients were premedicated with Glycopyrrolate 4mcg/kg I.V, Midazolam 0.03mg/kg I.V, Ondansetron 0.08mg/kg I.V and Fentanyl 2mcg/kg I.V. Patients were pre oxygenated with 100% Oxygen for 3 minutes. Patients were induced with Propofol 1.5 - 2mg/kg I.V. After ensuring adequate mask ventilation, patients were paralyzed with Rocuronium 1 mg/kg I.V. Patients were placed in sniffing position and laryngoscopy was done with Kingvision video laryngoscope with channelled blade, Airtraq videolaryngoscope or Macintosh laryngoscope as per group allocation. Laryngoscopy was performed by an experienced anaesthesiologist (Minimum 25 insertions with Airtraq and Kingvision

each in clinical setting were done by the intubating anaesthesiologist before starting the study).

Kingvision video laryngoscope and Airtraq video laryngoscope were inserted from the midline, reaching up to glossoepiglottic fold, then the blade was lifted gently for visualization of glottis. The preloaded appropriate sized ET tube was advanced into the glottis following which it was slided out of the channel.

Macintosh laryngoscope was inserted from the right side of the mouth. By pushing the tongue to left side, advancing the tip of the blade into vallecula, blade was gently lifted for visualisation of glottis.

After achieving best possible view of the glottis, anaesthesiology resident was asked to report the vocal cord visualization using the modified Cormack-Lehane grading (grade 1-4). If an adequate glottic view for intubation was not observed by the viewer, manipulations were performed. The number of patients who required external laryngeal manipulation was also noted. Patients were intubated with endotracheal tube of 7.0 mm internal diameter in females and 8 mm internal diameter in males. During intubation, modified Cormack Lehane grading (table 4 and figure 12), IDS score (table 2 and 3), time taken for intubation, number of intubation attempts, haemodynamics and any airway trauma were recorded. Finally, laryngoscope was removed, and breathing circuit was connected. The adequacy of ventilation was confirmed by chest auscultation and capnography. A curtain was placed such that the anaesthesiologist recording IDS score, duration of intubation, airway trauma and hemodynamic parameters were blinded to the group allocation. The endotracheal tube was secured and anaesthesia was maintained as per institutional protocol. Heart rate, mean arterial pressure and spo2 were recorded at intubation and at 1st min, 3rd min and 5th min after intubation. If the first intubation attempt failed, a next attempt was made after mask ventilation for 1 minute. Tracheal intubation was considered a failure if it could not be accomplished in three attempts and airway was secured using I gel. Intubation time was defined as the time from insertion of laryngoscope beyond incisor teeth until successful intubation confirmed on capnography

The following parameters were noted:

1. Ease of Intubation based on IDS score
2. Duration of Intubation (in Seconds)
3. Hemodynamic variables during intubation (Heart rate, mean arterial pressure).
4. Airway trauma.

Table 2: intubation difficulty scale (IDS) score2

Parameter	**Score**
Number of attempts for single attempt $N_1 = 0$, For every additional attempt add 1 point	N_1
Number of operators for single operator $N_2 = 0$, For every additional operator add 1 point	N_2
Number of alternative techniques If there is no need for alternative technique take $N_3 = 0$, for each alternative technique add 1 point. Repositioning of the patient, change of materials (blade, ET tube, addition of a stylet), change in approach (nasotracheal/orotracheal) or use of another technique (fibroscopy, intubation through a laryngeal mask).	N_3
Cormack Lehane (CL) grading Apply CL grade for 1st oral attempt CL grading I – $N_4 = 0$ II – $N_4 = 1$ III – $N_4 = 2$ IV – $N_4 = 3$	N_4
Lifting force required Normal – $N_5 = 0$, Increased – $N_5 = 1$	N_5
Laryngeal pressure Not applied – $N_6 = 0$, Applied – $N_6 = 1$	N_6
Vocal Cord mobility Abduction – $N_7 = 0$, Adduction – $N_7 = 1$	N_7
Total IDS = sum of all scores from N_1 to N_7	

IDS Score	**Degree of difficulty**
0	Easy
1-5	Slight difficulty
> 5	Moderate to major difficulty

Table 3: Modified Cormack Lehane Grading3

MCLG Grade	**Portion of glottis visible**
1	Visualisation of entire glottic aperture
2a	Visualisation of part of the glottic aperture
2b	Visualisation of only arytenoids or atleast parts of the laryngeal aperture
3	Visualisation of the tip of the epiglottis
4	No visualisation of the epiglottis or glottis

Statistical Analysis: Data Entry was done using Microsoft excel and analysis done using SPSS version 29.0.2.0. Qualitative data was expressed in frequencies and percentages and quantitative data in mean and standard deviation. Parametric tests include Anova test for intergroup comparison. Non parametric test which include Chi-square test was used for qualitative data. Bar diagrams and pie chart were used to represent the data. p value of <0.05 was considered statistically significant.

RESULTS

Out of 102 patients included in this study, 12 were excluded and remaining 90 patients were included in the study protocol. The three groups were comparable with respect to age, sex, BMI, ASA grading and SARI score (table 4).

In group K, 28 (93.3%) patients were intubated in the first attempt, and 2 (6.7%) patients required a second attempt. In group A, 27 (90%) patients were intubated in the first attempt, and 3 (10%) required a second attempt. In group M, 26 (86.7%) patients were intubated in the first attempt, and 4 (13.3%) required a second attempt. The difference in the number of attempts among the three groups was statistically insignificant (p value = 0.69).

In group K and group A, alternative techniques for intubation were not used in any of the patients. In group M, alternative techniques for intubation were not used in 21 (70%) patients and alternative techniques like bougie insertion was used for intubation in 9 (30%) patients. The difference in the number of alternative techniques used for intubation among all the three groups was statistically significant. (p value = 0.0001).

In Group K, 26 (86.6%) patients had MCLG 1, and 4 (13.3%) patients had MCLG 2a. In Group A, 25 (83.3%) patients had MCLG 1, and 5 (16.7%) patients had MCLG 2a. In Group M, 15 (50%) patients had MCLG 1, 7 (23.3%) patients had MCLG 2a, 7 (23.3%) patients had MCLG 2b and 1 (3.4%) patient had MCLG 3. The differences in the Modified Cormack and Lehane grading between the three groups were statistically significant (p value = 0.002).

In groups K and A, lifting force was normal in all patients. In group M, lifting force was normal in 11 (36.7%) patients and increased in 19 (63.3%) patients. The difference in the lifting force among the three groups was statistically significant. (p value = 0.0001).

In groups K and A, no patient required laryngeal pressure. In group M, laryngeal pressure was not applied in 9 (30%) patients and applied in 21 (70%) patients. The difference in the need for laryngeal pressure application among the three groups was statistically significant (p value = 0.0001).

Based on above-described parameters, IDS score was calculated (table 5). In group K, IDS score was 0 in 26 (86.7%) patients, between 1-5 in 4 (13.3%) patients and >6 in 0 (0.0%) patients. Mean IDS score was 0.2 ± 0.55. In group A, IDS score was 0 in 25 (83.3%) patients, between 1-5 in 5 (16.7%) patients and >6 in 0 (0.0%) patients. Mean IDS score was 0.26 ± 0.639. In group M, IDS score was 0 in 11 (36.7%) patients, between 1-5 in 18 (60.00%) patients and >6 in 1 (3.3%) patient. Mean IDS score was 1.9 ± 1.953. The difference in the IDS score among the three groups were statistically significant with p value = 0.001

The mean time taken to intubate was 27.2 ± 4.01 sec in Group K, 26.43 ± 3.98 sec in Group A and 17.56 ±5.29 sec in Group M. The differences observed was statistically highly significant (p value = 0.001). Two patients in group M had airway trauma.

Patients in group K and group A had lower postintubation HR and MAP in comparison to group M and the difference was statistically significant [Table 6 and 7].

Table 4: Demographic data, MPG grading and SARI score.

Variable	GROUP K	GROUP A	GROUP M	P value
Age	36.50 ±9.58	35.56 ±11.09	34.46 ±8.95	0.41
Gender M/F	11/19	10/20	9/21	0.86
BMI	22.26 ± 1.09	22.44 ± 1.12	22.26 ± 1.05	0.75
ASA status I/II	16/14	16/14	16/14	1
Modified MPG ½	15/15	14/16	15/15	0.95
SARI score 0/1	30/0	30/0	30/0	1

Table 5: IDS parameters.

Variable		Group K	Group A	Group M	P value
Number of Attempts for intubation	1	28	27	26	0.69
	2	2	3	4	
Number of operators	1	30	30	30	1
	2	0	0	0	
Number of alternative techniques	0	30	30	21	0.0001
	1	0	0	9	
MCLG	1	26	25	15	0.002
	2a	4	5	7	
	2b	0	0	7	
	3	0	0	1	
Lifting force	Normal	30	30	11	0.0001
	Increased	0	0	19	
Laryngeal pressure	Applied	0	0	9	0.0001
	Not applied	30	30	21	
IDS score	0 (easy intubation)	26	25	11	0.001
	1-5 (slight difficulty)	4	5	18	
	>5 (moderate to major difficulty)	0	0	1	
		0.2 ± 0.55	0.26 ± 0.639	1.9 ± 1.953	
POGO score	100%	26	25	15	0.0004

	50-100%	4	5	7	
	25-50%	0	0	8	
Time taken for intubation		27.2 ± 4.01	26.43 ± 3.98	17.56 ± 5.29	0.001
Airway trauma	Present	0	0	2	0.209
	Absent	30	30	28	

Table 6: Heart rate

Timeline	GROUP K	GROUP A	GROUP M	P value
Basal	86.13 ± 8.25	87.97 ± 7.42	90.00 ± 6.78	0.14
Intubation	101.07 ± 6.80	100.10 ± 5.27	113.57 ± 5.26	0.001*
1 min	93.17 ± 5.50	93.40 ± 5.24	103.93 ± 4.20	0.001*
3 min	91.20 ± 7.69	87.90 ± 5.87	95.20 ± 4.54	0.001*
5 min	90.67 ± 5.16	86.97 ± 5.66	90.13 ± 3.69	0.009*

Table 7: MAP

Timeline	GROUP K	GROUP A	GROUP M	P value
Basal	91.60 ± 6.15	90.70 ± 6.18	91.17 ± 5.77	0.84
Intubation	104.33 ± 7.58	101.57 ± 4.61	109.97 ± 4.51	0.001*
1 min	98.07 ± 7.21	95.40 ± 4.01	101.70 ± 3.23	0.001*
3 min	93.60 ± 7.44	89.63 ± 4.36	94.67 ± 3.42	0.001*
5 min	92.80 ± 5.40	89.53 ± 4.42	90.73 ± 2.99	0.01*

DISCUSSION

Endotracheal intubation is the gold standard for securing the airway and is conventionally performed with a direct laryngoscope. One of the main causes of anaesthetic morbidity and mortality, both within and outside the operating room is unsuccessful tracheal intubation.

Macintosh laryngoscope blade remains the standard device for laryngeal visualization. It requires the alignment of oral, pharyngeal, and tracheal axes to obtain a direct view of the glottis. To provide a better laryngeal view, the Macintosh blade necessitates head extension and tongue displacement. Recent advances in optical technologies have made it possible to create innovative indirect laryngoscopes. The ability to observe the laryngeal inlet without the need to align the oral, pharyngeal, and tracheal axes was a common characteristic of these devices, which may have made laryngeal visualization and subsequent tracheal intubation simpler to perform.

Over the past several decades, several novel optical airway devices have shown promise in adult airway management. As a means of managing difficult airway, the video laryngoscope is a well-established technique that has received substantial support in the literature.

The Simplified Airway Risk Index (SARI), or El-Ganzouri Risk Index (EGRI),[1] is a multivariate risk score thought to estimate the risk of difficult tracheal intubation. SARI is more sensitive and specific than MMG for prediction of difficult intubation and we excluded patients with SARI score more than 4. In our study, all patients had SARI score of 0. This indicates that all the patients in our study had very less chance of difficult intubation.

Intubation Difficulty Scale: Intubation difficulty scale score was introduced by Frederic Adnet et al,[2] in the year 1997. It is a quantitative scale of intubation difficulty useful for objectively comparing the complexity of endotracheal intubation. Several authors have utilized IDS score in their studies for grading the ease of intubation.[3]

Similar to McElwain et al,[4] and Maharaj et al,[5] in our study also the difference in the number of attempts among the three groups was statistically insignificant. (p value = 0.69). Second attempt in Kingvision and Airtraq was due to increased secretions obscuring the vision of glottis, which necessitated suction and cleaning the tip of camera. Need for alternative techniques, increased lifting force and external laryngeal pressure was significantly more in group M in comparison to group K and group A [Table 2]. Kaur R et al,[6] and Carassiti M et al,[7] also observed increased lifting force with DLS in comparison to TAScope and Glidescope respectively.

Group K and group A patients had better viewing angle than group M, thus explaining higher number of patients having CL grade I in Group K and group A in comparison to group M [Table 2] and our observations were similar to findings by Raghavendra Babu et al,[8] Mc Elwain et al,[4] S. R. Lewis et al,[9] and Ali et al.[10]

Patients in group K and group A had lower IDS score than group M in our study. IDS score of 0 was observed in 26, 25 and 11 patients in groups K, A and M respectively. None of the patients in group K and group A had IDS score of 6 and above in comparison to 8 patients in group M. The mean IDS score was 0.2 ± 0.55, 0.26 ± 0.639 and 1.9 ± 1.953 in groups K, A and M respectively. The difference in the IDS score among the three groups was statistically significant with p value = 0.001. similar findings were observed by Malik et al,[11] Moningi et al,[12] Hosali et al,[13] Patel et al,[14] Jain et al,[15] Nandakumar KP et al,[16] and Kumari et al.[17]

The intubation duration was lesser with the group M (17.56 ±5.29 sec) than group K (27.2 ± 4.01 sec) and group A (26.43 ± 3.98 sec) This difference was found to be statistically significant (p = 0.001). The Kingvision and Airtraq video laryngoscopes have a preformed curvature and a channel for installing the

endotracheal tube. This probably permitted limited scope for adjustments with the endotracheal tube during intubation. The whole assembly, the device, and the endotracheal tube had to be manipulated for adjustments that probably may lead to an increase in the duration of intubation, leading to an increase in the time to intubate with Airtraq laryngoscope. McElwain et al,[4] Kaur R et al,[6] Sherif M. Elhadi et al,[18] and Bhandari G et al,[19] also observed increased time for intubation with video laryngoscopes.

Laryngoscopy and endotracheal intubation result in sympathetic stimulation that leads to an increase in heart rate and blood pressure. Heart rate and MAP increased in all the three groups after tracheal intubation but had returned to baseline within 5 min. The fluctuations in HR and MAP were more pronounced in group M as compared to group K and group A. ($p < 0.05$). The findings in our study probably reflect that both the devices Kingvision and Airtraq video laryngoscopes provide a good view of the glottis without a need to align the oral, pharyngeal, and laryngeal axes and requires less force to be applied during laryngoscopy. This helps to produce less stimulation of HR and MAP than Macintosh laryngoscope that may be particularly advantageous in clinical situations requiring better control of HR and MAP, such as coronary artery disease or arrhythmias.

The injury that occurs with the video laryngoscope differs from that of the traditional intubation. Video laryngoscopes have a steep learning curve and complications like airway trauma are reduced with increased expertise. In our study, airway trauma was observed in two patients with Macintosh laryngoscope and none in the patients with Kingvision video laryngoscope and Airtraq video laryngoscope. With video laryngoscope, during intubation, airway structures are in the operator's view, and hence cricoid pressure and external laryngopharyngeal manipulation are less needed and reduce the incidence of throat injury.

Limitations of the Study

1. Patients with anticipated difficult intubations were not included. Therefore, the advantage of these devices in difficult scenarios could not be assessed.
2. The study needs to be conducted in a larger sample size.
3. As the study was conducted in normotensive patients, the advantage of Kingvision or Airtraq video laryngoscopes in decreasing the stress response to intubation cannot be extrapolated to patients with hypertension and coronary artery disease.

CONCLUSION

Our study concludes that Kingvision video laryngoscope and Airtraq video laryngoscope provided better intubating conditions with greater ease of intubation, better visualization of glottis, lower IDS scores and better hemodynamic stability in patients without anticipated airway difficulty in comparison to Macintosh laryngoscope. Time taken for intubation was lesser with Macintosh laryngoscope. Though the time required for intubation was more, lifting force was not increased, no airway trauma was present and there was no need for laryngeal pressure application with Kingvision video laryngoscope and Airtraq video laryngoscopes.

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